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GRAY'S PRESCRIPTIONIST

A TREATISE

ON THE ART OF READING AND COMPOUNDING
PHYSICIANS' PRESCRIPTIONS, WITH TABLES OF
WEIGHTS AND MEASURES, ANTIDOTES,
ABBREVIATIONS, ETC.

BY

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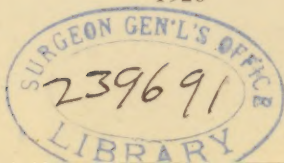
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Preface.

Three classes—patients, physicians and pharmacists—are vitally concerned in the writing, compounding and dispensing of prescriptions, and under recent laws dealing with narcotic and alcoholic liquors, the public generally is admitted to have some interest also.

This treatise, intended primarily to discuss compounding and dispensing, has been broadened in this revision, the third, and now includes a brief discussion of the problems involved in formulating and writing a prescription. There have also been added several pages on packaging the prescription in the forms preferred by up-to-date customers.

Necessarily, much that might have a bearing on prescriptions has been omitted, but it is believed that most of the matters of importance have been discussed at least briefly and in all cases clearly and concisely. It has been taken for granted that our readers have some knowledge of pharmacy, pharmacology and therapeutics.

While an effort has been made to present the subject in the simplest manner possible, our readers are requested to bear in mind the fact that before writing a prescription the physician should have exercised a most comprehensive knowledge and his best judgment in arriving at the conclusions thus written and that the pharmacist likewise has opportunity in compounding and dispensing to demonstrate his technical skill and professional training.

Well written prescriptions are a result of a thorough education in medicine, just as accurately and correctly compounded prescriptions are a culmination of thorough training and long experience in pharmacy.

In no way does this volume replace, or make unnecessary, reference to more complete and elaborate books on Pharmacy, Therapeutics, Chemistry, Pharmacology, Materia Medica, etc.

The questions that arise before students just beginning the consideration of prescription work have been given careful attention, and there has been an earnest effort to make an easily followed path for students in both medicine and pharmacy.

February 1st, 1920.

THE PRESCRIPTION.

Definition.—A written prescription is a part of a medical treatment and may be compared to a letter addressed to a pharmacist giving a written order to take or bring from his stock certain articles, as named, compound them if necessary, package and label them with instructions regarding use or dosage, and to deliver the article, thus prepared, to the patient.

The English word “prescription” has its root in the Latin word “scribo,” I write: as commonly used this word may mean either the written order for the medicine or the medicine itself.

How Formulated.—The physician who writes the prescription and also the pharmacist who compounds it should acquire a certain routine for approaching the problems involved in this work. When thoroughly learned and persistently practiced, such routine does much to eliminate errors, to quicken the work and in all cases helps to avoid the appearance of indecision, uncertainty and doubt.

The pharmacist who is to compound the prescription should be acquainted with the way in

which it has been put together, since he thereby obtains a better understanding of the purpose and intent of the prescriber.

Having made a diagnosis of the case and chosen the line of treatment, the physician should decide upon the medicament or drug required and then select the form or preparation that is the most suitable representative of the drug or medicament wanted for the case at hand.

After making the decision to order certain articles, but not before then, the actual writing of the prescription may begin by writing first the names of these articles, then the direction, if any, to the compounder, and next the directions to the patient for use or dosage: after writing these directions the total quantity prescribed may be calculated and written and then the quantity of each article, if more than one be ordered, should be noted.

When the prescription has been written, the physician should make it his never failing practice to read it carefully and verify his work before giving it to the patient.

Writing Directions.—The names of the drugs should be written in Latin, using official names whenever possible, but the directions should be in English, using exactly the wording that is wanted on the label.

Very clear, definite directions are always desirable and, in addition, the use of the medicine should be explained to the patient.

The pharmacist should make no change in the directions, copying the wording to the label exactly as it appears on the prescription. Many customers prefer that the pharmacist should also verbally explain the dosage of the medicine, but some discretion should be exercised in doing this.

An obligation rests on both physician and pharmacist to assure themselves that the patient thoroughly understands the use and dosage of the article ordered and dispensed.

Why Latin Titles Are Used.—The symbol $\mathcal{R}$, often printed or written at the beginning of a prescription, was symbolical of the prayer to the deity Jove—being a distortion of the astronomical sign of the planet Jupiter—which in ancient times was the first part of the treatment given by the priests who practiced medicine: nowadays, this symbol is usually written as $\mathcal{R}$, and is assumed to be an abbreviation of Recipe, meaning “take thou.”

If the drug prescribed has an official name, such name should always be used when writing prescriptions, since the official name has a definite meaning in regard to purity or strength which is understood by pharmacists in most parts of the world. These official names are Latin words and prescriptions are usually written in Latin for several reasons, of which the most important are:

First: Latin is the language of science the world over; it being a dead or unspoken language, is not subject to change by the addition of new words and phrases, and changes in spelling, like the modern languages.

Second: It is generally necessary, and always well to conceal the identity of the remedies or medicines from the patient; the use of Latin accomplishes this practically, as the language, especially the part used in a prescription, is understood by comparatively few.

Third: Latin names are distinctive and exact; some drugs have various common names, and some names are used for more than one drug. Again,

the vernacular name of a drug, and especially vegetable drugs, may be one thing in English and a different thing in French or Swedish, etc. The use of Latin at once obviates all these difficulties, saving one the trouble of learning the names in all the different languages.

"*Humulus*" is the Latinized name for hops; anywhere in the world if "*Humulus*" appears on a prescription it is known at once that "strobiles of *Humulus lupulus*, Linne," is the article wanted; thus it is seen that "*Humulus*" is the universal scientific name for the drug. The English name is hops; French, houblon; German, hopfen; Swedish, hululekottar; Danish, humle.

By using the Latinized name the necessity of learning the vernacular, or common name, in the different tongues is avoided.

Capital Letters.—Except prepositions, each word of the title should begin with a capital letter, whether it be written in full or abbreviated.

Abbreviations.—If the names of drugs are abbreviated, the abbreviation authorized by the Pharmacopœia and National Formulary should always be used.

For the name of a drug not official the abbreviation, if used, should be so plain and different from other abbreviations that there can be no doubt about which drug is ordered.

In general, abbreviations should be avoided except for words that are names of classes of preparations such as Tincture, Elixir, Syrup, etc.

A Latin title for a drug is, of course, given the same abbreviation whether it be in the nominative or in any other case as required by the grammatical construction of the sentence where it appears.

Grammatical Construction.—Official names are given in the Pharmacopœia and National Formulary in the nominative case, which in Latin, as in English, is used for words that are the subjects of sentences, and the ending of these Latin words change when these names become the objects.

In prescription writing as now practiced by nearly all physicians a skeleton, only, of the full wording is written.

If ten grains of codeine are wanted the complete instruction to the compounder or dispensing pharmacist would be, "Take thou ten grains of codeine"; in actual practice the sign *R* symbolizing the instruction "take thou" may or may not be written at the beginning of the prescription, but in either case it is understood by the pharmacist that the drug named is wanted in the prescription and that he should "take it," i. e., bring it to the compounding table and weigh or measure it or compound it as ordered by the prescriber.

The quantity to be taken or used in compounding is in the objective case in the English sentence or in the accusative when changed to Latin. Since the quantity is usually expressed in symbols and Roman numerals, or in Arabic if metric units are ordered, the case endings give us no immediate concern here.

The phrase "of codeine" in English is translated into Latin, using the official Latin title "Codeina," and giving this word the genitive ending—the genitive case in Latin corresponding to the English objective following the preposition "of."

The English sentence, "Take thou ten grains of codeine," thus becomes for prescription writing,

Codeinæ grs. X.

If the official title contains two words or more, the grammatical construction remains the same, but it is well to remember that such an English name as bismuth subnitrate when rendered into Latin becomes "the Subnitrate of Bismuth"—hence Bismuthi, genitive, meaning "of bismuth," and Subnitras, nominative, meaning "the subnitrate." This official title, "Bismuthi Subnitras," when written in full in prescriptions, should be changed to "Bismuthi Subnitratis": both words are thus put into the genitive and the English translation is "of the subnitrate of bismuth."

If thirty mils (Cc.) of tincture of iodine are ordered, the full statement in English becomes, "Take thou thirty mils of tincture of iodine."

For tincture of iodine the official Latin title is Tinctura, nominative case, the tincture, and Iodi, genitive, of iodine.

For prescription writing only the case ending of the first word Tinctura needs changing, and when so written the order appears as,

R—take thou

Tincturæ—genitive, of the tincture

Iodi—genitive, of iodine

Mils 30

By far the larger number of prescriptions involve but little more of Latin grammar than do the examples given.

In some prescriptions where stock pills or tablets are ordered it is customary and is better practice, because opportunities for mistakes are lessened, to write the name of the stock article and direct that a certain number be dispensed: in other words, the dispenser is ordered to deliver to the patient the article itself and not a certain portion or quantity of it.

A prescription for compound rhubarb pills constructed as suggested would be as follows in English: "Take thou the compound pills of rhubarb to the number of twelve."

The official Latin title for these pills is,

Pilulæ—nominative plural

Rhei—genitive

Compositæ—adjective; case ending to agree with noun modified (Pilulæ)

Note that the grammatical construction of this sentence differs from the preceeding examples: "pills" is in the objective case in English and follows a transitive verb: when translated into Latin it should be in the accusative case, in which the ending for this word is "as."

Skeletonizing the English sentence and changing to Latin as written in prescriptions, we have,

Take thou	R	
Compound		
Pills	Pilulas	plural accusative
of Rhubarb	Rhei	genitive
	Compositas	adjective, case ending to agree with noun modified (Pilulas)
to the		
number	numero	ablative
of 12	duodecimo	indeclinable

The accusative case is also used when a vehicle, solvent or diluent is ordered to be added to the other ingredients to bring the total measure up to a desired quantity: thus if there be wanted a total bulk or measure of four fluidounces, the instruction in English is, "Take thou water of sufficient quantity to make four fluidounces."

Skeletonized as in prescription writing "of suffi-

cient quantity to make" becomes quantum sufficiat, and this is abbreviated q.s.: the entire sentence then is written,

Aquam q.s. f̄ iv

When the prepositions "with" or "for" are used in English the noun following them is in the objective case, but when translated into Latin should be put in the ablative—hence the English title Mercury with Chalk is translated into Latin as,

Hydrargyrum—nominative, mercury
cum—preposition, with
Creta—ablative, chalk

When written in a prescription this becomes,
Hydrargyri—genitive, of mercury
cum—preposition, with
Creta—ablative, chalk

For a more complete review of the changes in termination of names in prescription writing reference should be made to a Latin grammar for rules for declension of nouns and adjectives and for the classification of the name words of drugs into the various declensions with case endings and gender.

All nouns occurring in titles used in the Pharmacopœia fall into the first, second or third declensions, except that some few drug name words are indeclinable, such as Elixir, Alcohol, Salol, Cusso, etc.

Only a few Latin verbs are used in prescription writing.

Few prescribers attempt to write anything except very general instructions for the compounding of the medicament ordered.

Written instructions covering such details are entirely unnecessary if the prescriptions are com-

pounded by any registered pharmacist, and especially is this true since the Pharmacopœia and National Formulary have been so carefully revised and adapted to present requirements.

If for any reason the usual general instructions must be supplemented by specific or detailed orders, these latter should be written in English, so that the physician may be sure the order is as he wants it, and so that the pharmacist may make no error in translation at the time of compounding.

In by far the greater number of prescriptions the directions to the compounder are limited to the three verbs:

First, recipe—take thou—implied from the symbol $\mathcal{R}$, written at the beginning of the prescription.

Second, misce—mix—written just after the names of the ingredients.

Third, signa—mark thou—written just before the directions to the patient.

Less frequently the following verbs are used:

Imperative; object, if written, should be
in accusative

Adde—add	Filtra—filtre
Cola—strain	Macera—macerate
Divide—divide	Solve—dissolve
Extende—spread	Tere—rub
Fac—make	

Subjunctive, having subject or predicate
in nominative case

Bulliat—let (it) boil
Fiat—let (it) be made (into)
Fiant—let (them) be made (into)

To acquire ease in writing prescriptions and in using Latin titles and phrases correctly it is sug-

gested that the student practice first writing the complete prescription in English without any abbreviations or omissions; then that those parts which should be in Latin be translated and this Latin translation be skeletonized as given in the examples above.

A list of Latin phrases and abbreviations used in prescription writing is given just before the index.

Prescription Blanks.—A prescription blank is the paper upon which the prescription is written, and it is highly desirable that this blank have printed on it the name of the physician, his office and residence addresses, hours, telephone numbers, blank lines for narcotic registry number, date and name of patient; if the prescriptions are to be written in the metric system, a perpendicular line about one inch from the right hand margin as shown on page 109 is very desirable and prevents mistakes due to misplaced or indistinct decimal points.

The printed information is of much assistance if it becomes necessary for the pharmacist, nurse or patient to confer with the physician before the medicine is compounded, either because of an omission, error or obscure direction.

A written prescription has always been an important document legally, but with the recent increase in laws and governmental regulations somewhat restricting the freedom of a physician in prescribing it has become of great importance that a physician be able to show a clear record of his prescriptions.

The easiest way to keep such a record is by using carbon paper and taking an exact duplicate of each prescription, and for this purpose it is desirable to use blanks bound in pads with every alternate one perforated: the pads of copies may be

filed for future reference and if always dated are easily found after referring to the patient's history card or ledger account.

Records of prescriptions for narcotics and for alcoholic liquids must always be available for inspection by officers of the law having the duty of enforcing laws regarding these articles.

A serviceable size for a prescription blank is three and one-half by five inches.

Whether the blanks be printed at the expense of the physician or furnished as a matter of courtesy by the pharmacist, they should comply with the form outlined above or should not be used.

The patient's name, or at least initials, should be written on the prescription and may be of much help in identifying the prescription when compounded and ready for delivery.

Plain, Distinct Writing Necessary.—According to custom, prescriptions are one class of written documents in which only handwriting is acceptable: for nearly every class of documents except treaties of state and prescriptions for drugs, typewriting has by common consent been accepted as better than handwriting and is binding in law when properly signed.

Since practically all pharmacists have adopted the practice of typewriting the directions on labels on prescriptions, it is only reasonable to hope that physicians may soon begin to typewrite, at least those prescriptions written in their offices; carbon copies, always desirable, are easily taken in typewriting and are satisfactory protection against alterations after the original prescription is given to the patient.

When handwriting is necessary it should be very

clear and distinct; at this time, poor handwriting is not accepted as a mark of genius. Poorly written prescriptions have been the cause of serious mistakes in dispensing, of much friction between the prescriber and the dispenser, and properly put the prescriber on the defensive in all discussions relating to the prescription.

Since several laws and regulations make it the duty of various inspectors to read prescriptions for narcotics and alcoholic liquors, the physician is by inference required to write these so that they may be easily read and be clearly interpreted. As a matter of self-protection, a pharmacist is justified in refusing to receive, dispense or file a prescription so poorly or obscurely written that he would be required to interpret it to legal officers when checking his file.

Dosage Calculations.—The calculations that arise in questions of dosage and of quantity to be prescribed fall easily into a few general classes and are very simple if the composition of the prescription has followed the lines suggested above.

In general, it is very undesirable to prescribe large quantities of drugs unless the patient thoroughly understands and agrees with the reason for so doing.

Enough, only, should be ordered to supply the needs of the patient for a few days.

Consideration should now be given to the package or container required for dispensing the prescription; patients and pharmacists, also, expect that prescriptions for liquids will completely fill the bottle used; for ointments, completely fill the tube, jar, or box; for powders, capsules, pills, cachets, suppositories, etc., this is not expected and

the quantity or number of these latter articles is not controlled by the size of the container used.

When these latter, divided-dosage forms of drugs—pills, tablets, capsules, etc.—are ordered, multiples of five or of four are convenient quantities to write for, since it is much easier to multiply the single dose by 10, 12, 16, 20, 24, etc., than by 9, 13, 17, etc. In dispensing, also, the total bulk may be more easily divided into the first named portions.

If the directions call for a dose before or after meals and at bedtime, four doses per day are required; if every three hours, five per day are usually taken, and hence the patient also may be better served by a number selected from the first named quantities. To find the number of doses to be taken in one day, divide 16 hours—about the normal period of wakefulness—by the number of hours between two successive doses: if a dose is ordered every two hours, 16 divided by 2 equals 8 doses per day.

If a liquid is prescribed, one teaspoonful is a desirable bulk for a single dose, quickly comprehended by a patient and easily measured: this quantity may be taken usually at a single swallow and yet is sufficiently bulky to dissolve the usual dose of many chemicals, etc., without making a solution irritant because of its concentration.

Many physicians make it their routine practice to so compose all their prescriptions for liquids that one teaspoonful may be taken at a dose.

To accomplish this, a vehicle, solvent or diluent is added to the active medicament. See Vehicles.

If the directions order a single dose to be for example, one teaspoonful, one fluidrachm, the vials

or bottles in use in the United States will contain the following number of doses:

$\frac{1}{2}$ floz.....	4	4 floz.....	32
1 floz.....	8	6 floz.....	48
2 floz.....	16	8 floz.....	64
3 floz.....	24	16 floz.....	128

If the dose be a dessertspoonful, each bottle will contain one-half as many doses; if one tablespoonful, one-fourth as many.

Other sizes of bottles than named in the foregoing table are not ordinarily available for dispensing prescriptions.

To meet the general desire that a liquid prescription fill the bottle it is necessary that one of the numbers suggested above be selected as the total number of doses, and the chosen vehicle should be ordered in sufficient quantity to make the total bulk or volume of the medicine equal the capacity of the bottle containing the desired number of doses.

If the medicine is to be taken in doses of one fluidrachm—one teaspoonful—three times daily, and this dosage is to be taken for a week, a total of 21 doses are wanted: in the table 24 is the nearest number of doses that will completely fill a bottle; 24 doses, then, should be ordered and a 3 fluidounce bottle used in dispensing the medicine.

If four doses, of one dessertspoonful, 2 fldrs. each, are to be taken daily for one week, 28 doses are wanted but 32 is the nearest number of doses that will fill a bottle containing not less than the quantity desired: 32 dessertspoonfuls, requiring an eight-ounce bottle, should be ordered; the solvent or diluent is then added in sufficient quantity to make eight flozs. (f $\overline{3}$ viii).

Having in this way decided upon the total bulk of the medicine and the total number of doses, multiply the quantity of the chosen drug wanted in one dose, expressed in grains or minims, or Grams or Mils (Cc.), by the number of doses: the product, if in grains or minims, should be changed to the larger denominations, drams or ounces, fluidrachms or fluid ounces, and then written on the prescription after the name of the drug: if the product is expressed in Grams or Mils (Cc.) no change to a larger denomination is necessary. A more detailed explanation of such calculations is given in the chapter on Weights and Measures, since an understanding of the relations of the various units is necessary in solving these problems.

When the quantity for a single dose multiplied by the total number of doses gives a product containing a fraction, the nearest whole number is usually ordered: thus if thirty-two doses are wanted, and the single dose is $\frac{1}{3}$ gr., the exact quantity wanted is $10\frac{2}{3}$ grs., but all necessary purposes are served if either 10 or 11 grains are written on the prescription.

If the drug ordered is very potent and the quantity small so that an error of much over five per cent would be caused, the exact quantity should be written. The variation due to individual peculiarities in the response by several patients to exactly the same dose of drug is more than the apparent error thus introduced by using whole numbers.

Moreover, there is usually more or less question about the accuracy of the measurement by the patient of the doses: some physicians prefer to estimate that one fluidounce will contain only six teaspoonful doses because the domestic teaspoonful varies in size, and even when the same spoon is

used different quantities are considered by different patients to be a teaspoonful.

The Pharmacopœia declares one teaspoonful to be equivalent to one fluidrachm or four Mils (Cc.), and for this reason these equivalents are used throughout this treatise.

The fractional grain weights available for use on prescription balances are $\frac{1}{8}$ grain and its multiples— $\frac{1}{4}$, $\frac{1}{2}$ gr. When other than these fractions are ordered, it is good practice to weigh 1 gr. or other small, convenient quantity and dissolve this in an accurately measured volume of a suitable solvent—water, diluted alcohol, diluted acid, etc.—and then take such fractional part of this solution as represents the desired weight of the dissolved solid.

If $\frac{1}{16}$ grain of atropine sulphate is wanted, $\frac{1}{2}$ grain may be accurately weighed and dissolved in sufficient water to make 40 minims; if 40 minims represent $\frac{1}{2}$ grain, one minim represents $\frac{1}{40}$ of $\frac{1}{2}$ or $\frac{1}{80}$ grain; if $\frac{1}{16}$ grain is wanted as many minims must be used as $\frac{1}{80}$ grain, the quantity in one minim, is contained in $\frac{1}{16}$ grain, the quantity wanted; to divide one fraction by another, they should both be reduced to a common denominator which in this case is 80 and hence $\frac{1}{16}$ grain is changed to $\frac{5}{80}$ grain. $\frac{5}{80} \div \frac{1}{80} = 5$ or 5 minims of solution, each minim representing $\frac{1}{80}$ grain of atropine sulphate, are equivalent to $\frac{1}{16}$ grain of atropine sulphate and this quantity—5 minims—is used in the prescription.

Solutions or triturations of this kind are also exceedingly convenient when the set of weights used on the prescription balance does not contain a weight equal to the fractional part of a grain written in the prescription—for example $\frac{1}{3}$ or $\frac{1}{5}$ grain.

Twenty-four doses of $1/120$ grain each total $1/5$ grain but if this exact quantity is wanted there is no way to obtain it conveniently except by measuring 12 minims of a solution containing 1 grain in 1 fluidrachm, or by weighing 2 grains of a 10 per cent trituration, since none of the sets of weights ordinarily used in prescription compounding contain a weight of this denomination— $1/5$ grain.

In many stores a few stock solutions of alkaloids or other powerful drugs are kept on the prescription counter: these may be made to represent 1 grain in 1 fluidrachm, or in 10 minims, or in any other ratio that experience has shown most serviceable.

Such solutions if kept in stock should be prepared in very small quantities—not more than will be used in a few days—and all precautions used to insure sterility.

If the stock solution is used on prescriptions for internal use only, sterility may be preserved by using chloroform water as the solvent or a few drops of chloroform may be added to the solution in sterile water.

If used in eye-lotions or in hypodermic injections the chloroform should be evaporated by a very gentle heat before the solution is dispensed or the stock solution may be made to contain 1 : 500 of phenol or cresol, similar to solutions of bacterins.

Since solutions may be measured much more quickly than powders or crystals may be weighed, much time may be saved by having on the prescription counter, concentrated solutions of salts such as iodides or bromides. When such salts are prescribed in liquid form these solutions may be used in compounding provided the water in the solution is not incompatible with the other ingredients. Many other time-saving schemes may be developed

by an ingenious pharmacist who closely observes the prescriptions brought to his store.

For some prescription dispensing it is also desirable to have a small quantity of trituration containing 10 parts by weight of a drug and 90 parts by weight of milk sugar—10% trituration— $1/10$ grain of drug in 1 grain of trituration.

If atropine sulphate is ordered in capsules each to contain $1/120$ grain and 12 are wanted, the total quantity of atropine sulphate wanted is $1/10$ grain— $1/120$ grain $\times$ 12 = $12/120$ grain = $1/10$ grain. One grain of the stock trituration of atropine sulphate made as above suggested contains $1/10$ grain of active drug and hence one grain of this trituration should be weighed and used in compounding such a prescription.

Analysis.—For the purpose of study, a prescription may be considered to consist of various parts, viz.:

PRESCRIPTION.	{	1. Superscription.	{ Consisting of a symbol, <i>R</i> , an abbreviation for the imperative verb, <i>receipe</i> , meaning <i>take thou</i> . In French prescriptions <i>Pr.</i> or <i>P.</i> is used and stands for <i>Prenez</i> .
		2. Inscription.	{ Basis. Adjuvant. Corrective. Excipient or diluent.
		3. Subscription.	{ The directions to the compounder.
		4. Signature.—	Directions to the patient.
		5. Prescriber's name, registry number and the date.	

The following is an example of a theoretical prescription:

Superscription—*R*.

Inscription.	{	Morphinæ Sulphatis... <i>Grs. iv. Basis.</i>
		Tincturæ Aconiti..... <i>ʒi Adjuvant.</i>
		Syrupus Rhei..... <i>ʒii Corrective.</i>
		Aquæ Anisi Q. S..... <i>ʒiv Vehicle.</i>

Subscription.—*Misce secundum artem.*

Signature.—*A teaspoonful every three hours.*

Date, registry number, name.

4-7-'95 T. B. Gray, M. D.

No. 43,857

The above prescription was written for facial neuralgia. The adjuvant (tr. aconite) assists the basis, morphine, by decreasing heart action. The syrup of

rhubarb acts as the corrective by overcoming the constipating effect of the basis, and the anise water serves as the vehicle in which the rest are administered.

A prescription may, however, contain the basis alone, or the basis with the adjuvant, or the basis with a simple vehicle or diluent. A single ingredient may serve a double or treble office, as in the case of some compound syrup or tincture. Again the basis may need no aid in doing its work, or corrective of its action, nor any special vehicle for its administration. On the other hand there is no limit to the number of ingredients which may be used, provided there is something to be accomplished by each, and also provided there is no chemical or physiological incompatibility between them.

It is now considered the best practice to have but one therapeutically active drug in a prescription and, if necessary, to add only such adjuvants, correctives, flavors, etc., as will make it most acceptable to the patient. If the effects that follow the administration of two or more drugs are wanted, separate prescriptions of each may be written; have but one purpose to be accomplished by one prescription and have one prescription for each object sought.

PREScription DISPENSING

The Prescription Department.—We will leave the general arrangement of the prescription case to the individual idea of each pharmacist, as there is no uniformity of opinion on the matter; we mention a few points which may contribute to convenience and accuracy in compounding. A separate closet should be attached to the case for very powerful and poisonous drugs, and the pharmacist should avoid keeping two dangerous drugs with similar names in close proximity to each other.

A most important feature of the prescription case is the prescription balance.

All prescription departments should be furnished with at least two prescription balances, one to be used for weighing small quantities (never over thirty grains), and the other for larger quantities up to one ounce.

By keeping a balance for small quantities, its delicacy will be retained for a very much longer time than if used for all weights.

Since accuracy and correctness in compounding depends so largely on accurate and correct meas-

urements and weights, the cleanliness and sensibility of the balances used is an index to the kind of compounding practiced. Clean, sensitive balances, well cared for, are the best kind of advertisement a prescription store can offer to an observant physician or thoughtful customer.

The prescription balance should be cleaned with water, and if care is exercised nothing else is needed.

It should always be enclosed in a case, protected from the air and dust.

Equipment of Apparatus and Utensils.—The apparatus required to completely equip a prescription counter varies according to the prescriptions brought to the store.

Just as clean, well-cared-for balances and graduates denote accuracy in compounding, so does an assortment of apparatus, utensils or tools indicate that the work at a counter so equipped is something more than pouring from one bottle into another.

Have a plentiful equipment, let it be seen in use and thus frequently and persistently demonstrate that the prescription department is prepared to give the best of service and is able to handle prescriptions of all kinds. As a rule, the most skilled craftsman uses the best tools and is quick to buy new ones required for new work.

Both for extemporaneous compounding and for manufacturing pharmaceutical preparations the following apparatus, in addition to two balances, is desirable: plenty of graduates of all sizes, spatulas of steel and horn, mortars and pestles of different shapes for pills, solutions and emulsions, glass stirring rods, tiles, a pill cutter, pill rounder, an apparatus for sealing cachets, a suppository machine,

porcelain capsules, Florence flasks, a chemical thermometer, sand bath, water bath, Bunsen burner or spirit lamp, funnels, filtering paper, litmus paper, infusion mug, casserole, specific gravity bottle, hydrometer, test tubes and graduated burettes, percolators, files, cork screws, numbering and dating stamps, typewriter.

Importance of Skillful Manipulations.—Compounding and dispensing prescriptions is the highest expression of pharmaceutical art and skill. Accurately and correctly compounding prescriptions and neatly dispensing them, in an attractive form, is the culmination of thorough training and long experience in pharmacy, together with plentiful facilities and resources in stock and equipment.

Each pharmacist who compounds prescriptions should, in handling utensils, in weighing, in measuring, in such work as trituration, filling capsules, rolling pills, folding powders, and in all other manipulations necessary, strive to develop a skill and technique that will impress the customer, especially a physician, with his neatness and dexterity.

Physicians and customers are rightly very fastidious and exacting in regard to cleanliness, sterility, accuracy and careful attention to details.

The manipulations necessary for dispensing the prescription even if it be only pouring from one bottle to another, or counting a dozen tablets, should be performed so neatly and carefully that the customer or observer will recognize that the dispenser is qualified and "knows how."

Compounding and dispensing of this class is usually given without any grumbling, a higher money value by the customer than are slovenly and careless methods.

Tablets and pills should be counted out on a clean powder paper or direct into the box, and never poured into the palm of the hand.

The dispenser who washes his hands frequently and keeps his finger-nails well cleaned when filling capsules or folding powders, will have a larger business-following than one who is not so careful.

No dirty utensil should be allowed to stand on the prescription counter. After using, they should be immediately cleaned, sterilized if necessary, and put in place.

Care of Utensils.—Each and every utensil should have a specific place, so that when needed it can be found without delay. When used each article should be properly and perfectly cleaned and returned to its place.

To cleanse vessels of adhering resinous tinctures, essential oils, etc., first scrub with plenty of soap and powdered pumice, and a little water; then, if necessary, use a little alcohol, but remember it is expensive; elbow exercise is cheaper. When colloidion has been measured and before the ether has evaporated pour the vessel full of water when a film is precipitated on the surface of the vessel; the film contracts so that it can be removed without any inconvenience.

For cleaning graduates, mortars, tiles and spatulas of oils, ointments, etc., first scrub with plenty of sawdust, removing all the grease possible, after which use soap, pumice and water; sometimes benzine is necessary; it is best used on a cloth. To remove iodine use ammonia water or hyposulphite of soda.

All utensils should be perfectly dried after being washed. A graduate might be required before

having time to dry and the adhering water would make a difference in the amount so measured.

Both the Pharmacopœia and National Formulary give instructions for sterilizing apparatus and bottles for use in compounding. In the preparation of medicines many of which are designed to overcome symptoms resulting from the presence of pathogenic micro-organisms in the human body, it is surely very desirable to take such precautions as will prevent the introduction of more micro-organisms with the remedy.

Hence there is an increasing demand for something more than apparent cleanliness in both apparatus and technique. Conditions and technique on the prescription counter must approach, at least, conditions and technique in bacteriological laboratory work; approximate sterility, at least should be secured.

Bottles and glassware, after being cleaned thoroughly with water, rinsed with distilled water and drained, should be plugged with cotton, wrapped in paper and heated to 180° C. for one hour. At this temperature, the paper should brown slightly or char. Do not unwrap the article until required for use.

Wet sterilization, by steam under 15 pounds pressure continued for 15 minutes, is more generally used in bacteriological work: an autoclave or pressure sterilizer is required.

Immersion for 15 minutes, at least, in alcohol, chloroform, ether, phenol or cresol solutions, or long exposure to moist formaldehyde vapor is often a convenient and effective way of sterilizing mortars and pestles, glass rods, spatulas, pill tiles, hypodermic tablet moulds, suppository moulds, etc.

Books of Reference.—In compounding prescriptions it often becomes necessary to refer to books for information. This should not embarrass the beginner and does not embarrass the experienced pharmacist. Be quick, however, to find what you want, and don't use the book in the presence of the patron, as he will likely think you lack competency and lose confidence in you.

Every druggist should possess a library, the more extensive the better, but a *Pharmacopœia*, *Dispensatory*, *Medical Dictionary*, a good work on *Pharmacy*, one on *Materia Medica* and one on *Chemistry* are absolutely indispensable to a first-class drug store.

The prescription counter should, by all means, be as systematic in its general arrangement as possible; the drugs should be in alphabetical arrangement. A special compartment should contain the most poisonous drugs; further than this the requirements and conveniences of each individual store should be the guide.

Reading Prescriptions.—Do not start to compound the prescription until it has been read all the way through. There are no exceptions to this rule. Read over the name of each ingredient, and the quantity, the instructions to the compounder, the directions to the patient.

If any part of the prescription is not clearly written, it is useless to begin compounding until the whole prescription can be translated and understood.

If there is an overdose, real or apparent, self-protection makes it necessary to clear up this point before the work of compounding is begun.

If the prescription in itself is readable and requires no correction, make sure that all the in-

redients are in stock before beginning the work of compounding.

One of the most common inquiries from a customer when handing a prescription over the counter is "how long will it take?" In some stores it is the rule to always tell the customer how much time will be required whether he does or does not ask.

Before any promise on this point is made, however, the pharmacist waiting on the customer must be assured that the medicament prescribed is in stock or quickly obtainable, that there is no defect in the prescription, and that there will be no delay from any cause, in the compounding; this practically makes it necessary to read the prescription immediately it is received.

Very little can be written to assist the beginner in learning to read prescriptions, as his ability to master this branch of the profession depends almost entirely upon his general knowledge of drugs and his actual experience in handling physicians' prescriptions. Therefore the beginner should make it a constant practice to read and thoroughly master every prescription filled in the store each day; this can be done during his hours for study, and is about the only way to gain proficiency.

In reading a prescription, if the name of an ingredient is somewhat obscure or doubtful, one is often assisted in determining it by referring to the quantity ordered, the other ingredients, or the form in which the medicine is to be prepared; either of these will sometimes suggest what the obscure item is, though they more often have no bearing on the matter. If it is the quantity of an ingredient you are in doubt of, it can often be decided by considering the dose of the ingredient, as for instance, where one

is at a loss to decide whether a character is intended for a drachm or an ounce sign.

Whenever you are not perfectly familiar with any article in the prescription refer freely to your dispensatory or other works of reference. The pharmacist who considers himself so competent that this is never necessary is a dangerous man, and young men too often fail to avail themselves of this help through false modesty or fear of being thought incompetent.

Identification of Prescription.—If more than one prescription is presented at one time by a customer, learn if all are for the same patient, if not, put names on each label; serious accidents have happened by neglect of this point.

Not only must care be taken to see that a prescription be carefully compounded but it is also equally important that the customer receive the medicine called for by the prescription which he brought to the store.

If a customer receives medicine intended for some one else, serious consequences may ensue, both to the customer and to the store.

As a rule the customer knows nothing about what kind of medicine has been prescribed for him or at the most, knows only that it is a powder or a tablet or a liquid.

In general, the most satisfying way of identifying the prescription, is to have the customer's name written on the prescription, on the label, and on the outside of the package when ready for delivery.

Identification checks, numbered or lettered, are used in many stores and given to the customer when a prescription is presented.

When a prescription is to be used by the customer himself, mistakes in delivery are often

avoided by having the customer repeat the dosage that the physician told him to use and comparing this with the directions on the package which the pharmacist is about to give him. Even if the directions are not repeated in detail it is desirable that the pharmacist be assured that the use of the medicine is understood by the customer, before it leaves the store.

Calculate Dosage Before Compounding.—Before a prescription is compounded, the dosage given should be carefully scrutinized. The pharmacist should practice calculating the total number of doses in the quantity ordered; then divide the total quantity of each ingredient prescribed by this number; the result will be the quantity of each ingredient taken at a single dose.

In this way the pharmacist should assure himself that the dosage when taken according to the directions to go on the label, is not an overdose. Always determine the dose of each ingredient of each prescription you compound.

Overdose.—If this dosage, as written, is an overdose or in any way exceeds the quantity recognized by authorities as safe, do not compound the prescription until you receive assurance that no injury will result to the patient and that the unusual quantity is desired by the physician.

When a doubt arises as to an apparent overdose of some dangerous drug in a prescription, the pharmacist must use good judgment and quick decision, bearing in mind that his first duty is to protect the patient and next to protect himself and the physician, and that a physician's mistake does not excuse a pharmacist before the law. The first point is to gain time without exciting suspicion in the

mind of the customer. This can be done by informing him that it will be some time before the medicine is prepared, and offer to deliver it or request him to call for it at a specified time. After thus disposing of the customer see the writer of the prescription and satisfy yourself as to whether or not it should be dispensed as written. If the physician cannot be found at the time and you consider it necessary to dispense the medicine, either for the good of the patient or to protect the physician, do so by reducing the dose of the dangerous ingredient to a safe limit and notify the physician at the earliest possible moment, and any honorable physician will appreciate your precaution. It sometimes happens that even after such cases have been brought to the notice of the doctor he will insist that the dose is all right. In such cases if the pharmacist still thinks it an overdose he should refuse to dispense it, and if he has reason to consider the doctor ignorant and incompetent it becomes his duty to inform the customer his reasons for such refusal, though caution and judgment should be exercised.

Omissions.—Often physicians omit to specify the quantity of one or more of the ingredients in a prescription, or the number of powders, pills, etc., into which it is to be divided. In such cases there is only one course to pursue, viz., see the doctor and have the omissions rectified.

Checking Compounding.—Whenever possible, the work of compounding should be checked, using whatever scheme or system is best adapted to the immediate circumstances.

Mistakes in handling poisonous drugs are to be guarded against in every way possible; and mistakes not involving poisons, are often very em-

barrassing, always an injury to the reputation of the store and humiliating to the pharmacist.

If circumstances permit, re-checking all work in the prescription counter by a clerk other than the one doing the compounding, is desirable but in many stores this can not be done and is always expensive.

No system of checking is so successful in preventing mistakes as a rigidly enforced rule to attend strictly to what you are doing and do only one thing at a time: mistakes generally occur from absent mindedness or at a time when the dispenser is giving attention to more than one thing.

Every intelligent and skilled pharmacist can check his own work himself and often do this better than any one else, knowing that upon him alone is the responsibility for the work. Divided responsibility is undesirable no matter what system is used.

Give close attention to the work at hand. Do one thing at a time and know the purpose of the work, and after the prescription is compounded and before it is given to the customer, let the compounder himself check over the steps taken.

Containers.—A feature of the utmost importance is the container used for dispensing the article prescribed. A well chosen container, perfectly clean, neatly labeled and sealed and wrapped inspires the customer with confidence in the accuracy and correctness of the compounding and does as much as any other one feature to bring business to the prescription counter.

There is obtainable in the market a great variety of bottles, jars, tubes, boxes and cartons in various shapes and colors; reference should be made to the price lists of manufacturers and jobbers since the

space available does not permit describing these articles here.

In many instances where two prescriptions are dispensed to the same patient or to the same family and one liquid may be for internal while the other may be for external use, or the two may be ordered taken at different times, it is desirable that the bottles be of different shapes or colors.

At least two shapes or colors in pill and powder boxes are also desirable. A complete assortment of all the containers in stock in the store should always be at the prescription counter ready for immediate use, even though there may be room for only a few of each kind. This reduces the opportunity for both mistakes and delays.

Especial emphasis should be given to the urgent need for absolute cleanliness. Bottles, jars and metal boxes that shine from polishing and paper boxes that have the brightness of new articles all help to make the medicine attractive to the patient and to bring customers back to the store.

Both the Pharmacopœia and National Formulary give instructions for sterilization of containers. All bottles after washing should be thoroughly dried, and both for convenience and for cleanliness they should be corked before stocking on the prescription counter.

The best grade only of corks are suitable for use on prescriptions. For preparations and containers that have been sterilized the Pharmacopœia orders rubber stoppers, also sterilized.

Many physicians who prescribe ointments prefer that these preparations be sterilized, and the most suitable container for such ointments are collapsible tubes. A tube one inch in diameter and four inches

long will hold one ounce of ointment, unless the preparation be very dense, when a tube three-quarters inch diameter will be large enough.

If melted in compounding the partly cooled ointment may be poured into the tube: if mixed cold, the tube may be filled by using a spatula. The open end of the tube may be closed by flattening it about an eighth of an inch from the end against the counter with a spatula, and then folding over the flattened part; again flatten about an eighth of an inch and again fold over. A special tool for closing tubes, somewhat like a pair of pincers with broad jaws, is obtainable and very serviceable.

The label for a tube should completely encircle it, be as narrow as possible and be attached near the top. Tubes should be dispensed in cartons and a duplicate label be attached on the carton.

If, for any reason, tubes are not used, ointments compounded on prescriptions should be dispensed in jars, either amber or flint-glass, or porcelain-ware, impervious to fats or fixed oils.

The label should be attached to the side of the jar rather than on the cover.

If a tin ointment box is used, or if a label is to be attached to the cover of a jar, the metal surface should be well rubbed with sand-paper to remove grease, which prevents the paste from holding the paper on the metal.

For capsules, pills or tablets, square or round paper shouldered boxes are usually preferred; oblong boxes are used for powders. When tablets, capsules or pills are dispensed it is desirable to cover them with a layer of cotton after placing in the box; this prevents rattling and in some cases avoids spilling.

These dry preparations, if dispensed to persons traveling on the ocean, should be placed in well corked bottles or other moisture proof containers.

Protection from Light.—While numerous chemicals and liquid preparations may be dispensed in flint-glass bottles, without deterioration from exposure to light, the Pharmacopœia, by inference, recommends that a large number of articles be protected from such exposure when dispensed and for many articles definitely orders amber or dark colored glass.

Instructions are given that alkaloids and alkaloidal salts such as Codeine Sulphate, Cocaine, Morphine Sulphate, Atropine, etc., be protected from light, and it is self-evident that solutions of these articles, being more prone to change than the dry substances, should likewise be protected when dispensed.

Tinctures and fluidextracts made from crude drugs containing alkaloids are also protected to some extent from deterioration if kept in the dark.

Solutions of Silver Nitrate may change rapidly and show a dark colored precipitate, usually silver oxide, unless put in dark bottles.

Since the Pharmacopœia directs that carefully dried digitalis leaves be protected from light, the liquid preparations, infusion and tincture, should be dispensed with like safeguards.

While the National Formulary does not order amber or dark bottles for elixirs containing Iron in Ferric Compounds, such as Elixir Calisaya, Iron and Strychnine, it is easily proved by experiment that these elixirs, if kept in the dark, retain the desired light green color for a much longer time than if exposed to the light. The use of amber bottles when these are dispensed is therefore desirable.

Syrup Ferrous Iodide, on the contrary, is better kept in flint glass, but so far as possible exposure to air should be avoided. The Pharmacopœia directs that Mass of Ferrous Carbonate be exposed to light.

The pharmacopœial salts and preparations of mercury are all easily changed in color by exposure to light; and these chemicals as well as preparations such as tablets containing them, should be protected from such exposure, both while in stock and when dispensed.

Chloroform, especially if used for anaesthesia, should be dispensed in dark bottles.

Oleic Acid should be dispensed in glass or stone-ware containers only.

The following list names the more important drugs that, either while in stock or when dispensed, should be protected from light: the same protection should be given to preparations containing these articles:

Alkaloids and Salts	Chloroform
Aloin	Chrysarobin
Amyl Nitrite	Digitalis
Aspidium	Ether
Benzoic Acid	Ethyl Chloride
Benzaldehyde	Eucalyptol
Betanaphthol	Ferric Salts
Bismuth and Ammon.	Formaldehyde
Citrate	Hydrobrom. Acid Dil.
Bromoform	Hydrochloric Acid and
Camphor Monobromated	Dilutions
Chloral Hydrate	

Hydrocyanic Acid Diluted	Pyroxylon
Hydriodic Acid Diluted	Resin Podophyllum
Hydrogen Peroxide	Resorcinol
Hops	Salicylates
Iodides	Santonin
Iodine	Serums
Iodoform	Sodium Cyanide
Mercurial Compounds	Solution Arsenous and Mercuric Iodide
Methyl Salicylate	Spirit Nitrous Ether
Nitric Acid and Dilutions	Spirit Nitroglycerin
Nitrohydrochloric Acid and Dilutions	Spirits of Essential Oils
Oils,	Strophanthin
Essential, Volatile	Suprarenalin
Paraformaldehyde	Tannic Acid
Paraldehyde	Terebene
Parsley Seed	Thymol Iodide
Phenol and Phenolic Derivatives such as Guaiacol, Creosote, etc.	Tincture Iron Chloride
Pyrogallol	Trichloracetic Acid
	Uranium Nitrate
	Vanillin
	Veratrin
	Waters of Aromatic Oils

Corks and Stoppers.—Solutions of fixed alkalies, hydroxides or carbonates, should be dispensed in hard glass bottles free from lead and with rubber stoppers: if glass stoppers are used they should have a thick coating of petrolatum or paraffin. Cork stoppers for bottles containing Magma Magnesia should be coated with paraffin.

The Pharmacopœia orders glass stoppers for bottles containing Aromatic Spirit of Ammonia, Ammonia Water or Stronger Ammonia, Solution Iron Chloride, most of the liquid acids, Iodine and its solutions, Tincture Iron Chloride, Potassium Permanganate, Zinc Chloride.

Ethyl Chloride and Amyl Nitrite should be dispensed in hermetically sealed containers.

Solutions of Apomorphine Hydrochloride and as a rule, of most other alkaloids, should be dispensed in containers that before sterilizing have been first rinsed in diluted hydrochloric acid and then in distilled water: this acid rinsing takes any easily dissolved alkali from the glass.

Diagnostic Reagents Containers.—It is especially important that the containers for diagnostic reagents be selected with care and that the foregoing recommendations be carefully followed, especially for reagents containing strong alkalies, iron chloride, strong acids, etc.

Deterioration.—To prevent deterioration of his stock of drugs and to dispense none but drugs in prime condition should be the persistent endeavor of every pharmacist. This cannot be accomplished without unremitting attention to numerous details. The suggestions in the paragraphs dealing with containers for dispensing are also applicable to containers for stock in bulk.

In addition to these precautions, all available means should be used to guard against undue exposure to heat, light, air or moisture or other injurious agents or influences.

One of the most desirable safeguards is to have only such quantities of each article or preparation in stock as will be sold within a short period of time; fresh goods inspire confidence in their value

and make a strong appeal to the purchaser, and especially to a physician, who is vitally concerned in having his patients use drugs of pharmacopœial strength and purity. The Pharmacopœia and National Formulary set a definite time or age limit, after which the article should not be used, on only a few drugs, of which biological preparations are the most important, but it is admitted by these and all other authorities that very many drugs undergo some decomposition with age and lose both purity and potency.

An observant pharmacist using the opportunities that come in handling drugs should acquire ability to note any departure in taste, odor, color, consistency or other physical property from the accepted standard and it is very desirable that a physician prescribing the article should also familiarize himself with these same properties.

Moreover it is to be always remembered, that appearances of two samples of the same drug may be identical, but there may be a wide difference in their purity and potency, and this difference may be disclosed only when chemical or biological tests are applied.

No drug of doubtful quality should be dispensed; and the burden of proving that the drugs dispensed are of prime quality, rests on the pharmacist who dispenses them.

It is not within the purpose of this treatise to discuss the analysis of drugs for purity and potency and reference should be made to the United States Pharmacopœia and National Formulary for authoritative tests.

The United States Pharmacopœia IX and the National Formulary order that the following

articles be given special scrutiny just before being dispensed:

Diluted Hydriodic Acid (no blue color with starch paste—absence of free iodine).

Nitrohydrochloric Acid (1 drop added to 1 Mil of 20% potassium iodide solution liberates iodine, red-brown color—presence of chlorine).

Diluted Nitrohydrochloric Acid (5 drops tested as above).

Apomorphine Hydrochloride (a 1% solution in water should not give a green color at once).

Solution Arsenous and Mercuric Iodide (should not be darker than a pale yellow).

Ointment Rose Water (free from rancidity).

All biologicals—serums, etc.,—must be prepared in establishments licensed by Secretary of the Treasury of the United States (or Bureau of Animal Industry if for veterinary practice) and not used after expiration date on label.

Ether (kept in sealed filled containers and not to be used for anæsthesia if container has been opened longer than 24 hours).

Sterile Distilled Water (not to be used if more than 48 hours old).

Mucilage Acacia (to be frequently made).

Syrup Wild Cherry (no time limit set, but said to lose hydrocyanic acid rapidly).

Oleoresin Aspidium (mix crystals with liquid portion).

Oleoresin Cubeb (reject crystals if any are deposited).

Any drug, whether included or omitted from the above list, should be right when dispensed and the responsibility for its purity and potency rests on the person dispensing it.

Labeling and Sealing Container.—The directions, doctor's name, date, serial number of prescription, and name of patient should be in typewriting on the label; a numbering stamp and a dating stamp in addition to the typewriter are desirable for the complete equipment of the prescription counter.

Typewriting has almost completely displaced handwriting on labels on prescriptions.

On bottles, use a label as wide, but not wider, than one side of the bottle and about half or a third as long as the body of the bottle. Attach the label so that the space between its top and the shoulder of the bottle is one-half or one-third as wide as the space between the bottom of the label and the bottom of the bottle.

When the article is dispensed in paper boxes some pharmacists attach the direction label on the inside of the cover: here it remains clean longer than if on the outside, but customers usually consider it more conveniently placed when outside.

It is a wise precaution to put the serial number of the prescription and the name of the patient on the bottom of the box as well as on the cover; this may prevent mistakes arising from exchange of covers on boxes of the same size and color.

The prescription clerk has not finished his work until the filled container has been carefully cleaned, sealed and labeled. Bottles may be sealed by tying a paper cap over the cork or by a drop of sealing-wax on the side of the cork; boxes and cartons may be closed with a paper seal or with wax.

A sealed container delivered to the customer or to the patient is evidence that the medicine is in just the form prepared by the compounder and has not been tampered with and in addition is proof of

the care and attention given to details by the pharmacist.

Courteous Treatment of Customers.—Customers bringing prescriptions to the store should receive the most courteous attention and if it is necessary for them to wait until the prescription is compounded, they should have an opportunity to sit down and be comfortable. Should they leave the prescription and say they will call at a later time, every possible effort should be made to have the medicine ready for them and to give them prompt attention when they return.

It is the practice in many stores to send a messenger for a prescription and then to deliver the medicine when compounded. Whether this is desirable or profitable is altogether a matter of local circumstances.

It is always desirable to meet your customer's expectation of service. In general, the rule in most stores is to give the best service possible and to charge a sufficient price to cover the cost.

It is bad practice to compound a prescription according to instructions taken over the telephone. Prescriptions by telephone calling for narcotics and alcoholic liquors are not legal prescriptions and should not be dispensed. For such an article the written prescription must be in the possession of the pharmacist before it is dispensed.

A pharmacist who desires to develop a prescription business must obtain the support and confidence of a large number of people by the best kind of business dealings and, in addition, he must secure the approval, largely on professional grounds, of a number of physicians.

While a physician is probably entirely within his rights if he names the store from which the patient

should secure the medicine, this is not the best of practice and as a rule a pharmacist should make no effort to secure exclusive specification of his store by a physician.

The best business-building methods are needed for the development of a large prescription trade. The subject is too extensive for more than a mention of its importance in this treatise.

PREScription OWNERSHIP, PRESCRIPTIONS FOR NARCOTICS AND ALCOHOLIC BEVERAGES.

Control of the Prescription, Copying and Refilling.—The pharmacist has need to use much judgment and discretion in answering questions from customers about refilling, giving copies and numerous other matters concerning the prescription. Many of these questions are asked because the laity do not understand what a prescription is, the reason for putting it in writing, nor its importance as legal evidence in regard to drugs whose use is closely regulated by laws.

Generally the laity consider that a fee paid to a physician is paid for the prescription written and handed to the patient: holding this view of the transaction, they think themselves entirely within their rights in demanding the original or a copy of the prescription after it has been dispensed and also in distributing this copy to other persons, or in continuing to use the medicine without consulting the physician.

Both physician and pharmacist have been negligent in failing to educate the public to a better understanding of the true situation.

Requests for copies and for refilling prescriptions should be carefully considered, much tact used in either granting or refusing the request and in all cases such action taken as will fully protect all four parties—physician, pharmacist, patient and general public—whom our present laws recognize as usually concerned in the transaction.

No intelligent patient will refuse to admit that the fee paid to the physician included the charge for very much more than the written prescription; in many cases a fee is paid where no prescription at all is written: in all cases the charge, of course, is for the entire services of the physician including diagnosis, advice as to the use of both drugs and food, suggestions for right living and for much other work involving professional skill and training.

The instruction to the patient to use or to take certain medication is only a part of the service rendered by the physician: so that this instruction may be useful or effective, the physician is obligated to make such medication available or obtainable.

A verbal request that the patient obtain certain named drugs and use them is always unsatisfactory and in nearly all cases fails to accomplish its purpose.

The physician has only two other ways of meeting his obligation—either himself to obtain and deliver or administer the medicine to the patient or to give a written order which will authorize the delivery of the medicine by some other person.

The written prescription is such an order and it is addressed to the pharmacist or dispenser, even if his name be not given. The patient in the majority of cases assumes that the prescription is addressed to himself.

On the contrary, he acts merely as a messenger or carrier. The remark of the physician to "have this prescription filled" or "get this medicine" or "take this prescription to —— pharmacy" is so commonplace that the relation of this instruction to the prescription is not noticed by most people.

When the skeletonized Latin wording of the prescription is rendered into complete English sentences, there can be no doubt about whom the writing is addressed to.

The impossibility of the patient following the instructions for measuring or compounding makes it clear that the instructions must be addressed to some one trained in this work, if the prescription was written in good faith.

While being a written order for the delivery of a certain article, the prescription differs from the ordinary order for merchandise, in not making the writer financially responsible for the value of the goods delivered, in not being definitely addressed to or drawn on any named individual or firm, in not having a negotiable value, in being valid without regard to the consideration received, in being written by a person authorized by law to practice medicine, in being a part of a medical treatment, in the intent of the writer, which must be both to have the goods supplied and also to cure, relieve, mitigate or prevent a disease or abnormal condition in a patient, and in that the laws regarding narcotic drugs or alcoholic beverages direct how it shall be filed or preserved. If a physician writes an order for the purpose only of enabling a pretended patient to secure supplies of a drug this order is not a prescription because it is not a part of medical treatment.

No one would ordinarily expect a mercantile

house to return to the purchaser his written order on which it has made a delivery of goods: ordinarily, the order remains in the hands of the party delivering the goods as a part of the records of the transaction.

The pharmacist should retain the original prescription for this same reason: if a copy only of the prescription is retained, proof should be available that it is correct.

In some respects a better understanding of the purpose and place of the prescription is had if the patient be considered the object of the care of both physician and pharmacist.

A person sick and not able to care for himself calls a physician to take control of the case: the physician brings in to assist when necessary the nurse, the pharmacist, the sanitarian, the hygienist, the diagnostician and other trained practitioners: instructions may go to these persons directly or indirectly and the giving of these instructions is part of the duty of a physician when he assumes responsibility for the care of a patient.

The written prescription, directed to a pharmacist, whether named or unnamed, is only one of these instructions: in general, it resembles a letter from the physician in charge of the case to the pharmacist who is to compound the medicine needed.

When the directing officer of a mercantile organization or of a personal service corporation gives instructions to another member of the same organization regarding the service rendered to a customer or client, no ownership of these instructions is conferred on the person to whom the service is rendered, nor does ownership of the written prescrip-

tion, the instruction or order from the physician to the pharmacist, rest in the patient to whom the service of both physician and pharmacist goes.

Court decisions on the ownership of the prescription vary, but since the enactment of laws regarding the use, administration and dispensing of narcotics and alcoholic beverages have given a definite status to prescriptions for these articles it may safely be assumed that in most instances prescriptions for other drugs will take on a similar status.

Public welfare is concerned not only with the indiscriminate distribution of narcotics and alcoholic beverages, but also with the distribution of poisons, abortifacients and various articles used for self-medication in venereal diseases and in other contagious and infectious diseases.

The interest of the public generally in the prescription is secondary to that of the patient, but does exist and is recognized by recent laws and plainly points to a responsibility resting on both physician and pharmacist to hold the prescription as a clear record of a transaction; the correct filing and preservation of the written prescription is an important part of the duties of the pharmacist.

The foregoing views on the control of the written prescription, its filing and preservation rests primarily on the fact that the ultimate good of the patient, and the public as well, are thereby best served.

While fully accepting and maintaining these principles, there are numerous instances in which physicians and pharmacists find nothing wrong in giving a copy of the prescription to the patient or customer for future use or in refilling the prescrip-

tion without a definite order to this effect from its author.

Prescriptions for narcotics or alcoholic beverages may not be refilled or copied. There are no exceptions to this: but prescriptions for other medications, not habit-forming and not in themselves injurious if used freely, are frequently refilled or copied.

Persons traveling must under some circumstances retain a copy of the prescription written for them if the treatment is to be continued, and in many cases where the physician himself is temporarily out of reach or has been prevented from repeating his call on the patient, and the medication is to be continued, the prescription may be refilled to the advantage of all concerned.

Every pharmacist should learn the views of the physicians whose prescriptions come frequently to his store, if he can meet them personally and have a frank discussion of these problems with them.

When a pharmacist makes it his practice to refuse to refill prescriptions because it is a physician's wish that he so refuse, there is a measure of obligation resting on the physician to support this pharmacist in this attitude and to encourage the patients to continue to take their prescriptions to this store whose practice complies with the physician's wishes.

We may repeat that much judgment and discretion are called for when a pharmacist or a physician attempts to discuss with a customer or patient these various problems in connection with the written prescription and we may also repeat that both physician and pharmacist have been negligent in permitting the public to acquire a distorted idea of

the purpose and service rendered by the written prescription.

Neither original nor copy should be given to anyone except the original owner. Nobody, unless specifically authorized by law, should be permitted to look over the prescription file; the medicine often discloses the disease or affliction of the patient. It might sometimes be very embarrassing to the patient to have outside parties, or even members of the family, know his troubles, especially as they have no right to such knowledge.

In France the exposure of the prescription for the wife to the husband has been made grounds for damages (and judgment obtained) as well as criminal proceedings, which resulted in the druggist being fined.

Keep your prescription file in a private place and be careful about giving copies.

The pharmacist should not tell a customer the therapeutic action or effect of the medicine prescribed. Usually there is no difficulty in avoiding a discussion of this kind—especially so in a busy store.

If, however, such questions cannot be avoided it is best to state frankly that this is a matter which the pharmacist is not at liberty to discuss and that the physician considering the case in all its angles desires to accomplish certain results, which may prepare the way for further treatment of the disease, and that the responsibility for the choice of the drugs rests entirely on the physician and not on the pharmacist.

As we have said elsewhere, much discretion, good judgment and tact is needed in discussing these matters and what is right and even desirable in

some instances becomes seriously objectionable in others.

Prescriptions for Narcotics.—The Harrison Narcotic Law—the Act of December 17, 1914, as amended by the Revenue Act of 1918, approved February 24, 1919—contains several provisions designed to control the prescribing of opium or coca leaves or of any compound, derivative, salt or preparation of these articles.

Physicians, dentists or veterinary surgeons are required to register with the collector of internal revenue and pay a special tax of \$3.00 per year; the special tax for retail pharmacists is \$6.00 per year; and if the retailer is a manufacturer of preparations containing narcotics, he is classified as a manufacturer also and required to pay another special tax of \$24.00 per year; any dealer not a producer who sells these articles in original stamped packages is a wholesaler and for this class the special tax is \$12.00 yearly.

Practically all physicians and pharmacists are required to register twice and secure two permits—one authorizing them to prescribe or sell narcotic preparations subject to a special tax of one cent per ounce, and one covering the use or sale of preparations containing small quantities of narcotics and not subject to the special tax.

Each person so registered is given a serial number and this registry number must appear on orders or prescriptions which he may write.

While not specifically required by law to do so, a physician should for his own protection keep an exact copy of all his prescriptions containing narcotics; these copies should be filed in such a way

that they may be conveniently inspected by agents or inspectors from the collector's office.

Prescriptions for narcotics must be dated when written and signed with the name, address and registry number of the physician. The Commissioner of Internal Revenue has ruled that it is contrary to law for a physician to dispense a narcotic or to write an order simply for the purpose of making a habitual user comfortable by maintaining his customary use of such article and not for the purpose of curing the habit. Inspectors are instructed to regard the person who writes such an order, the druggist who fills it and the person obtaining the drug as all guilty of violating the law.

The bottle or other container in which the medicine is dispensed should be labeled with name and address of the patient, the names, addresses and registry numbers of both pharmacist and physician, and the serial number of the prescription.

Prescriptions for narcotics must be kept by the pharmacist in a separate file, and it is contrary to the regulations to copy or refill them.

Such prescriptions must be held open to inspection by employes, agents or inspectors of the Bureau of Internal Revenue or other officials engaged in enforcing state, municipal or federal laws regarding narcotics.

The law requires that a special internal revenue tax at the rate of one per cent per ounce be paid on preparations containing narcotics and that the stamp showing such payment be attached to the container; but prescriptions, if labeled as above, are exempt from this tax.

It is obligatory upon the pharmacist or the physician to keep himself fully informed about the requirements of the laws and regulations, and he can

easily do this by consulting the nearest office of the Collector of Internal Revenue.

Prescriptions for Alcohol and Alcoholic Beverages.—The laws and regulations issued by the Commissioner of Internal Revenue require that when alcoholic beverages are prescribed, the prescription must be written on a form supplied free of charge by the commissioner; these are bound in numbered books of one hundred forms; the prescription blank is attached to a stub, which must show a copy of the prescription written; when all blanks are used the stubs must be returned to the commissioner; all mutilated, defaced or unused blanks must be returned also.

In addition to using the official blank, the physician must keep an alphabetical record in a book showing to whom the prescription was issued, the date, the amount prescribed, the patient's ailment and the amount and frequency of the dose.

The law forbids writing prescriptions for alcoholic liquors except after a careful physical examination or for reasons based upon reliable information showing such prescription to be necessary for a known ailment.

Not more than one pint may be lawfully prescribed to be used by the same person within a period of ten days.

No prescription for liquors may be filled more than once and when filled the pharmacist must endorse thereon the word, "canceled," with date over his signature.

The pharmacist must keep a record showing the name and address of the purchaser and such other information as the commissioner may direct.

In all cases the requirements of state laws must also be complied with, and in general these order the pharmacist to file such prescriptions or a copy thereof with the state or county officer—usually the clerk of the county court—having supervision over liquor permits.

It is the intention of the Bureau of Internal Revenue to carefully scrutinize these records kept by pharmacists and to inflict penalties whenever it may appear that the alcoholic liquor was not required by the nature of the malady or that an unnecessarily large quantity has been prescribed or that the purpose and intent of the prohibition laws have been defeated, and in most of the cases the responsibility will be held to rest on the pharmacist, who it is assumed should have been sure all was right before dispensing the articles ordered.

To comply readily with the several laws and regulations, the pharmacist must keep three separate files of prescriptions—one for prescriptions ordering narcotics, one for those ordering alcoholic beverages, and one for prescriptions not included in the first two files. Each file should be numbered serially and kept entirely distinct from the other.

Like prescriptions calling for narcotics, those for alcoholic beverages should not be filled for any person other than the one named on the prescription, nor be copied nor refilled by the pharmacist.

While some may hold that alcoholic liquors are at times necessary and desirable remedial agents, by far the majority of physicians will not prescribe them, nor will the majority of pharmacists dispense them. By this refusal, which usually will be supported by public sentiment, very much troublesome work is eliminated, and a questionable trade done away with.

The position of the Bureau of Internal Revenue in regard to the need for wines for medicinal purposes is clearly stated in a ruling which says, "It is not believed that there is any legitimate use for wines for medicinal purposes, and since it is impracticable to determine the exact purposes of use when taken internally, except when used for sacramental purposes, no wines, as such, may be sold for internal use on a physician's prescription or otherwise as medicines. All wines must be so medicated as to preclude the probability of use as beverages when taken internally and to this end the instructions as to sworn data, samples, etc., applicable to non-beverage alcohol will be strictly applicable to non-beverage wines."

Two other paragraphs taken from the bureau regulations are to be noted as demonstrating the purpose of the Internal Revenue Bureau to hold the pharmacist strictly accountable for even non-intentional violations of the spirit of the law: "Attention is hereby called to the fact that nonbeverage alcohol cannot be dispensed to persons who do not hold permits, whether upon physicians' prescriptions or otherwise, except in a quantity of one pint or less, and on condition that the alcohol is first medicated according to one of the nine formulas," which may be secured from the Collector of Internal Revenue. "The so-called nonbeverage spirits and nonbeverage wines must not be dispensed on a physician's prescription, unless in the compounding thereof the same are so medicated as to render them absolutely unfit for use as a beverage. In case of prescription, the druggist will be held absolutely responsible as to the sufficiency of the medication."

If it is considered necessary to keep in stock and

sell or dispense alcoholic liquors, the pharmacist is obligated to keep himself informed of all the requirements of the laws and regulations. He can best do this by frequent inquiries at the nearest office of the Collector of Internal Revenue.

Even without changes in the law, administrative regulations are sometimes changed so radically that what was regarded as lawful at one time is considered as illegal at other times.

In general, these regulations provide that articles such as aromatic elixir and tinctures used as vehicles and not medicated sufficiently to destroy their potable qualities, shall bear a label declaring them to be made with nonbeverage alcohol and that the dispensing, sale or use of them as beverages or in unchanged form subjects the vendor or user to severe penalties. All physicians and pharmacists, even if homeopathic, are subject to the same restrictions, and the burden of proof to show that he is complying with the law is upon the person claiming the right to use or have alcohol or alcoholic liquors in his possession for other than beverage purposes.

In addition to wines, beer, gin, ale, porter, brandy, whiskey, etc., the Federal Internal Revenue Bureau includes under the term "alcoholic beverages" or "liquors" all pharmaceutical preparations containing more than one-half of one per cent of alcohol, unless they also contain in each fluidounce at least one average adult dose of a drug recognized by the United States Pharmacopœia, National Formulary or other standard authority.

If an average adult dose of the drug present is contained in one fluidounce, the preparation is not ordinarily classed as an alcoholic beverage.

A specific ruling should be obtained from the Commissioner of Internal Revenue or the Prohibition Enforcement Officer in any case where there is a question of the suitability of a preparation for use as a beverage. The penalties for violation of the law are so severe that the utmost care should be taken to comply with the legal requirements and in all cases where differences of opinion arise it is well to take every possible precaution to keep within the limits of lawful action.

WEIGHTS AND MEASURES

Weight Defined.—Weight is the measure of gravity or the excess of the attraction of the earth over that of surrounding bodies for articles on the earth; this measure is taken by comparing the excess of the earth's attraction exerted upon the article being weighed with that exerted upon accepted standards. Weight is a property common to all substances.

Volume Defined.—Volume is the extent or bulk of an article and, like weight, is measured by comparison with accepted standards.

Standards and Units.—Several of the standards once used and likewise several names for units of weights and measures are derived from easily found naturally produced objects.

The name "grain" is now used as a name of a weight because a grain of wheat taken from the middle of the ear and well dried was one of the first legal standards of weight named in English law.

Other terms, such as hand, foot, ell, stone, riding, etc., most of which are now obsolete in the United States, have a similar derivation.

The importance of accuracy in measurements caused these naturally made standards to be discarded because close observation proved them to lack uniformity when obtained under varying conditions of growth, collection, or preservation.

Gradually certain names are being universally accepted as units of weights and measures and it has been and is the earnest endeavor of many scientific workers to so define and describe these accepted quantities that they can be reproduced exactly if the apparatus or utensils now in use as measures and weights should be destroyed or if it should become necessary to prove the accuracy of these utensils.

Absolute proof of the accuracy of apparatus used for weights and measures cannot be had by comparison with other apparatus or utensils which, like the first, are subject to damage or change, but may be obtained by comparison with physical constants, natural forces or objects which so far as our knowledge goes have not been and cannot be changed or modified.

The length of a pendulum which makes a complete vibration in one second under definite conditions is used as a basis for the standards in Great Britain. Wave lengths of light and of sound have been carefully studied and measured, and this work, if reversed, would enable skilled observers to recreate our standards of length from light or sound waves produced under controlled conditions.

A meridian of the earth measured under elaborate precautions was chosen as the basis for standards of metric weights and measures.

The most painstaking study should be given to questions concerning such standards inasmuch as

all the immense trade, commerce and industry of the civilized world and, to some degree, nearly all human efforts are so measured.

Standard Apparatus.—After standards have been accurately fixed and widely accepted, it becomes essential to provide means for making and distributing exact copies of the units adopted.

Official bureaus of weights and measures are now established in nearly all parts of the world, and practically all of these, even though using different names for units, are in agreement as to the value of the various units used in measuring and weighing.

A few years after the signing of the constitution, the United States Government secured official copies of the standards held in London by the Government of Great Britain and later secured official copies of the standards of the metric units held in Paris.

In 1901 the Bureau of Standards was established in Washington and since then has done a great deal of experimental work to prove the accuracy of the official weights and measures.

A number of states have weighing and measuring apparatus which is in agreement with the standards in the Bureau in Washington and is held by the state officer charged with weight inspection, etc.

A number of commercial houses have likewise copies of those standards which are of direct importance in their business. A copy of an official standard weight or measure should be accompanied by a certificate from the bureau or official charged with the duty of testing such apparatus, certifying that the copy has been tested or compared with the standard and reporting the variation, if any.

from the standard: if the copy is almost but not quite exactly equal to the official standard it can be used if the variation or error is known and allowed for.

Most of the official standard weights and measures are made of metal, platinum, gold or silver being preferred because less acted upon by atmospheric influences, etc., and hence less changeable with age.

Derivation of Weight and Volume Units from Linear Units.—Linear measurements are so seldom used in prescription work that it is unnecessary to give those tables here, but measurements of length are the basis for most of the existing legal standards of weight or volume and for many persons, the best understanding of weights and measures is had by describing the weight or volume units in terms of linear measurements.

It is assumed that our readers are familiar with the value of the units of linear measurements and with the table 12 inches make one foot, three feet make one yard, etc. A space 5 inches by 5 inches by $9\frac{1}{4}$ inches ($231\frac{1}{4}$ cubic inches) corresponds almost exactly to one United States gallon (legally 231 cubic inches). From this the smaller units are derived; one fluidounce is approximately 1 inch by 1 inch by $\frac{4}{5}$ inch, and 1 minim is but little more than a cube $\frac{15}{100}$ of an inch on each edge, or more often is compared to a drop of water.

The metric measure Mil (cubic centimeter) corresponds to a cube measuring about $\frac{4}{10}$ inch on each edge, and the weight of such a cube of ice is almost exactly 1 Gram.

The exact value of and the relation between the units of weights and measures used in prescription work should be thoroughly understood. This is

essential: its importance can scarcely be overestimated; but this study is simplified if obsolete or seldom used names are eliminated and only the more commonly used terms retained; the value of these may be easily comprehended by comparison with familiar objects or by visualizing their dimensions in terms of linear measurements.

Liquid Measures.—The quantity of a liquid may be expressed by giving its weight or by giving the dimensions in inches or centimeters of the space which it occupies, but since liquids at once take the shape of the space, cavity or chamber into which they may be poured, the quantity is so much more easily and conveniently ascertained and expressed in terms of fluid measure that in the United States, at least, it is the accepted practice to so express the quantities of all liquid medicinal preparations and the unit "ounce" is generally understood to mean fluidounce if the article measured is a liquid or an ounce by weight, if the article be a solid.

This practice has spread into other lines of trade and in many states laws have been passed requiring that fruits, vegetables and other dry commodities once sold by the bushel, peck or quart, dry measure, should be sold by weight, pounds and ounces, instead.

In prescription writing the symbol $\mathfrak{f}\text{̄}$ is interpreted $\mathfrak{f}\text{̄}$, fluidounce, if written after the name of a liquid preparation; but if written after a solid is apothecaries ounce by weight.

Likewise, in prescriptions written in Metric weights or measures, the quantities written after liquids are called Mils (Cc.) and are measured by volume, while those written after solids are Grams and are weighed.

While no confusion is caused by this interpretation, it should be always remembered that the fluid-ounce, apothecaries ounce and avoirdupois ounce are not the same quantities. See the tables given in this chapter.

Fluid measure for prescription writing and compounding is the same as for all commercial fluid measurement: and the names mls, liters, minims, fluidounces and pints have the same value wherever used.

There are two systems of volume measurements for liquids and fluids in use in the United States—Apothecaries and Metric. In both of these there are a number of units that have become obsolete because usage has shown that if a few units are accurately fixed they may be multiplied many times without serious error.

Metric Measures of Volume.—Somewhat complete tables of both these systems are given at the end of this chapter, but in the metric system all ordinary requirements can be met by remembering that Mililiter, for which the United States Pharmacopœia IX gives the abbreviation Mil, is the volume of liquid that will fill a cube that is 1 centimeter (.3937 inch) long on each edge, or more accurately stated, is the volume occupied by 1 Gram of water at 4°C under standard atmospheric pressure (of 760 mm.)

These two definitions are not exactly equal, and for this reason the two names Mil and cubic centimeter are in use, but in ordinary medical and drug work the difference may be ignored. Exactly, 1 Mil is equal to 1.00027 Cc.

According to the U. S. P. IX, one Mil (Cc.) is about equal to one-fourth teaspoonful; for dosage

purposes one teaspoonful is calculated equal to about 4 Mils (Cc.).

While other units are given in metric tables, no other metric unit of volume measurement than Mil (Cc.) and its value need be memorized for prescription work.

On prescriptions, Mils are written in Arabic figures and fractional parts of Mils are expressed decimally—thus one-half Mil is .5, two and one-half Mils 2.5, etc. Usually the name Mil (Cc.) is omitted from the prescription. Thus, "Tincture Iodine 60." is understood to mean 60 Mils (Cc.) of the tincture measured by volume.

The utensils or apparatus commonly used in measuring liquids for prescription work are usually made of glass, either conical or cylindrical in shape, lipped and marked or graduated to deliver the quantities etched on the glass. Metric measures or "graduates" are usually cylindrical and are obtainable in capacities of 10, 25, 50, 100, 250, 300, 500, 1000 Mils (Cc.). Each of these sizes is also graduated for smaller quantities. Those sizes in black-face type are the more serviceable in prescription compounding.

No trouble should be experienced in securing accurately marked graduates in the market, but for prescription work their accuracy may be easily tested by weighing the quantity of pure water which may be poured out after the graduate has been filled to the mark. Under standard conditions the weight of the water should be as many grams as the graduates are marked Mils (or Cc.), that is, the quantity of water which fills a graduate to the line marked 50 Mils (Cc.) should weigh when poured out 50 grams, under standard conditions of temperature, etc.

Since heat expands liquids but does not change their weight, it is self-evident that a quantity of liquid having a volume of 100 Mils (Cc.) when at a temperature of 25°C will expand to a volume several Mils (Cc.) larger when at a higher temperature, say 75°C. While the volume will be larger, the weight has not increased, since no material has been added to it. Unless otherwise stated, it is understood that all volume measurements of drugs are made at about ordinary room temperature—20°C to 25°C.

Other apparatus for measuring liquids include pipettes, burettes, volumetric flasks, descriptions of which may be had in the catalogues of apparatus of chemical or pharmaceutical glassware for scientific work.

Apothecaries Fluid Measure.—In the English or Apothecaries fluid measure the requirements of prescription work are met by the units,

minim—approximately equal to 1 drop of water

fluidrachm—approximately equal to 1 teaspoonful

fluidounce—approximately equal to 2 tablespoonfuls

pint—approximately equal to 2 tumblerfuls

The relation between these units is,

60 minims (abbreviated M) = 1 fluidrachm (abbreviated fldr.), symbol $f\overline{3}$

8 fldrs. = 1 fluidounce (abbreviated floz.), symbol $f\overline{3}$

16 flozs. = 1 pint (abbreviated pt.), symbol O

A more complete table is given at the end of the chapter.

The United States Pharmacopœia IX considers one teaspoonful to be equal to one fluidrachm.

These quantities when written on prescriptions are expressed with Roman numerals preceded by the symbol of the quantity wanted: thus, if one fluidounce is to be indicated it is written $\text{f}\bar{\text{z}}\text{i}$, or more usually $\bar{\text{z}}\text{i}$. Fractional parts of fluidounces are written as fluidrachms: thus, since one fluidounce contains eight fluidrachms, one-half fluidounce is equal to four fluidrachms, and is written $\text{f}\bar{\text{z}}\text{iv}$, or, more usually, $\bar{\text{z}}\text{iv}$; occasionally, only, is it written $\bar{\text{z}}\text{ss}$ or $\bar{\text{z}}\text{fs}$ (ss = semi, one-half).

Thus, "Tincture Ferric Chloride $\text{f}\bar{\text{z}}\text{iss}$ " would be understood to be $1\frac{1}{2}$ floz. of the tincture: "Tincture Ferric Chloride $\bar{\text{z}}\text{ii}$ would mean $\frac{1}{4}$ floz. or 2 fldr. of the tincture. "Solution Potassium Arsenite M XLV" means 45 minims of the solution.

Usually, glass measures or "graduates" marked in the units of apothecaries fluid measure are somewhat conical in shape and are obtainable in sizes made to deliver 60 min, 120 min, 240 min, 1 floz., 2 floz., 4 floz., 8 floz., 1 pt., 1 qt.; all of these are also graduated or marked to measure smaller quantities than named. The sizes in blackface type are the most generally useful in drug work. Most of these sizes are also obtainable marked in both apothecary and metric units.

A glass graduate having rather thick walls and foot is easily cracked if quickly or unevenly heated and therefore unless otherwise specified, liquids should be at about 25°C . (77°F .) when measured; if it is necessary for any reason to measure a hot liquid it is advisable to wet all the inside surface

of the graduate with a few drops of the liquid before filling it to the desired quantity.

When glass graduates are to be sterilized by heat, less breakage results if each graduate be wrapped separately in gauze, placed in the cold sterilizer, and after heating the required time, allowed to cool before taking out of the sterilizer.

In measuring liquids it is necessary to have the surface of the liquid at right angles to the axis of the graduate when held upright and also to have the surface on a level equal to the line of vision.

Most of the graduates now on the market have some of the graduations etched all around the glass and the measurement is not accurate unless the liquid reaches the same mark on all sides.

The surface of the liquid in a graduate is not flat but is curved, and the bottom of this curved surface, or meniscus, is the point that should be brought equal to the mark indicating the desired quantity.

The bottles in use in the United States have the following capacities:

Metric Apoth.

15 Mils =	f $\bar{5}$ ss =	4 teaspoons =	1 tablespoon
30 Mils =	f $\bar{5}$ i =	8 teaspoons =	2 tablespoons
60 Mils =	f $\bar{5}$ ii =	16 teaspoons =	4 tablespoons
90 Mils =	f $\bar{5}$ iii =	24 teaspoons =	6 tablespoons
120 Mils =	f $\bar{5}$ iv =	32 teaspoons =	8 tablespoons
180 Mils =	f $\bar{5}$ vi =	48 teaspoons =	12 tablespoons
240 Mils =	f $\bar{5}$ viii =	64 teaspoons =	16 tablespoons
480 Mils =	Oi =	128 teaspoons =	32 tablespoons

The approximate values given above answer the usual requirements for prescription work.

Arranged in one table the commonly used units of fluid measure are

			Approximate equivalents.
16.2 minims	= 1 mil (or Cc.)		$\frac{1}{4}$ f3.
3.7 mls	= 1 fldr.	=	4 mls.
60 min.	= 1 fldr.		
8 fldr.	= 1 floz.		
29.6 mls	= 1 floz.	=	30 mls
16 floz.	= 1 pt.	=	480 mls
473 mls	= 1 pt.		

Weight Systems for Prescriptions, Trade or Research.—There are three systems of weights used in drug work in the United States—apothecaries, used only in writing or compounding prescriptions; avoirdupois, used in the ordinary commercial transactions in drugs, and the metric, which though used occasionally in buying and selling bulk quantities and somewhat frequently in prescription work, is practically the only system of weights used in analysis, research or similar scientific work.

As in the case of liquid measurements, usage has eliminated a number of units once thought desirable, and a few units of weight accurately fixed can by multiplying or dividing be fitted to all ordinary requirements of prescription work.

Metric Weights.—In metric weights there is need to memorize only two units—milligrams and Grams. As stated under fluid measure, a Gram is the weight of one Mil (Cc.) of water under standard conditions; one Gram is the weight of a cube of ice measuring approximately $\frac{4}{10}$ inch on each edge. One

1/1000 of this quantity is one milligram. Conversely, one thousand milligrams equal one Gram.

A complete table of metric weights is given at the end of this chapter, but these two units of weight, thoroughly comprehended, will supply all ordinary requirements in prescription work.

Gram and its abbreviation, Gm., are both written with a capital G to make them easily distinguished from "grain" and its abbreviation, gr., both written with a small g.

As is the case for liquid metric quantities, these quantities by weight on prescriptions are written in Arabic figures and decimally and the word Gram or milligram is omitted. One Gram is written 1. and forty Grams, 40.; one milligram is written .001 and twenty-five milligrams are 25/1000 of one Gram and are written .025; one-quarter of one Gram is 250/1000, and is written .250.

While milligrams are written as a decimal fraction they may be conveniently read as a whole number since the word milligram means thousandth part of one Gram; thus 250 thousandths of a Gram and 250 milligrams are two different expressions for the same quantity and the latter is the more desirable.

When read as a whole number the figures must be extended to the third decimal place, thus one-tenth Gram may be written .1, but when extended to the third decimal place is .100, and is then conveniently read as one hundred milligrams. If a metric quantity has one or more figures after the third decimal place, these latter figures may be read as a decimal fraction of one milligram: thus .0648 may be read as 64 8/10 mgm.

As stated under liquid measurements, metric or other quantities written after solids on prescriptions

are interpreted as weight, and if after liquids, as volume or capacity quantities.

Apothecaries Weights.—The units of apothecaries weight commonly used in prescription work are grains, drams and ounces:

60 grains (abbreviated gr.) equal one dram (abbreviated dr.—symbol $\mathfrak{z}$).

8 drs equal 1 apothecaries ounce (sometimes called troy ounce and abbreviated tr. oz.—symbol $\mathfrak{z}$).

1 apothecaries ounce equals 480 grs.

A more complete table is given at the end of this chapter. Both the word grain and the abbreviation gr. are written with a small g.

An apothecaries ounce is about equal to the weight of a cube of ice 1 in. x 1 in. x $\frac{7}{8}$ in. The weight of a cube of this size of other solids is not necessarily one ounce, usually more; nor does a cube of this size of other liquids than water always weigh one apothecaries ounce.

In considering the relations between units of weight and units of volume water is the substance upon which exact comparison is based.

There are no domestic equivalents for small quantities by weight since the bulk or volume of the same weight of different solids may vary greatly, a teaspoonful of calomel, for example, being many times heavier than a teaspoonful of powdered boric acid.

Since patients have then, no convenient way of accurately measuring single doses of powdered drugs, it is necessary when prescribing such articles to order the pharmacist to divide the bulk quantity into separate doses, each to be wrapped separately in paper, etc., or to prescribe such forms as tablets, pills, capsules, etc.

Avoirdupois Weight.—Avoirdupois weight, which is the system used in ordinary commercial transactions in drugs, uses the same grain (gr.) as does apothecaries weight; an avoirdupois ounce (av. oz.) contains 437.5 grains and 16 av. ozs. are contained in one pound (lb.).

Contrast this value in grains of an avoirdupois ounce ($437\frac{1}{2}$ grs.) with that of an apothecaries ounce—480 grains—and with the weight of a fluid-ounce of water under standard conditions—456 grains.

Note also that an avoirdupois ounce does not contain 8 apothecaries drams, or in other words, that $\frac{1}{8}$ av. oz. is not 1 dram (60 grs.) but is only $\frac{1}{8}$ of $437\frac{1}{2}$ grs. = $54\frac{11}{16}$ grs.

The units of avoirdupois and apothecaries weights are standardized in the United States by comparison with the units of metric weight rather than directly with physical constants, etc. The Bureau of Standards has shown that 1 grain is equal to .0648 Gm., or $64\frac{8}{10}$ mgm.

Combined into one table the various units of weight in common use in drug work are:

1000 mgm.	= 1 Gram.
.0648 Gm.	= 1 grain.
60 grs.	= 1 dr.
$437\frac{1}{2}$ grs.	= 1 av. oz.
480 grs.	= 1 apoth. oz. (tr. oz.).
8 drs.	= 1 apoth. oz. (tr. oz.).
16 av. ozs.	= 1 lb.

The foregoing brief table, together with the condensed table of liquid measure previously given, show the relative value of the units of weights and measures commonly used in prescription work and

if thoroughly understood give sufficient information for solving all ordinary problems and calculations in dosage and compounding. More complete tables are given later.

Formerly it was not considered good practice to name the quantites of some ingredients in the English system and of other ingredients in the same formula in the Metric system, but it is now becoming the custom to do so, since many pharmaceutical preparations, especially those for hypodermic, intramuscular or intravenous use, are compounded to contain a dosage named in terms of the English system in a volume of liquid named in terms of the Metric system.

Thus a statement that a solution contains $1/6$ gr. of Mercury biniodide in each 10 Mils (Cc.) is just as well understood by many men as if it be said that the liquid contains 1 6 gr. in $2\frac{1}{2}$ fldrs., because the syringe with which this injection is given is not marked in fluidrachms but in Mils (Cc.).

This practice will undoubtedly become more common because to some degree this mixing of terms makes it unnecessary to learn how to translate weights or measures in one system into weights or measures of another system, provided the value of the term used is understood in its own name.

This practice will also bring into general use such names and units as are most suitable for drug work and eliminate those less serviceable.

Balances and Scales.—Several designs and makes of scales and balances are in common use for weighing drugs, and there is no difficulty in procuring suitable ones if the purpose and work which they are to perform is understood. For description see the catalogues and price lists of dealers in scientific apparatus.

Any given scale or balance is best suited for weighing quantities falling within certain limits which in general are fixed by the way the balance is built, and the material of which it is constructed. The construction required to support five pounds must be much stronger and have heavier beams and bearings than that required for weights approximating five grains.

Balances having light weight but rigid beams and very sharp knife-edge bearings respond to or are sensitive to very small quantities, but this construction makes it inadvisable to weigh large quantities on these balances if this sensitiveness is to be retained after much usage.

The prescription counter should have a balance sensitive even after prolonged use, to $1/32$ gr. or to 2 mgm.: quantities over 30 grains should not be weighed on this balance.

Another balance so made as to respond to a weight of $1/8$ grain (or to 10 mgm.) should be on the prescription counter for use in weighing quantities from 30 grains to 1 ounce.

In addition to being more suitable for larger quantities, because of more rugged construction, this balance will come to rest more quickly and weighings be made more rapidly than on the former.

A counter scale sensitive to 5 grs. (or to $1/2$ Gm.) should be used for sales over the store counter and for quantities from one-half ounce to 5 lbs.

Most of the balances in use in the drug stores in the United States are constructed of a lever or beam mounted at the center on a bearing or knife-edge and having at each end a pan or receptacle—one to be used for the article being weighed and the other for the known weight.

Unequal arm balances, where the supporting knife-edge is placed close to one end of the beam—dividing it into two unequal parts or arms, are commonly used for quantities larger than 5 lbs.

For very large quantities, balances or scales with compound levers are used but prescription compounding or ordinary drug store sales at retail offer no field for such heavy apparatus.

Quite a large number of "torsion" balances are in use, called torsion because the lever or beam is securely fixed in a horizontal plane on a flat wire instead of resting loosely on a knife-edge, and this wire undergoes twisting or torsion when a weight deflects the beam.

Weights are obtainable in sets of from $\frac{1}{2}$ gr. to 10 grs. or from $\frac{1}{2}$ gr. to 2 drams (120 grs.) and two of these latter will supply sufficient weights for ordinary prescription compounding. Metric weights are available in sets ranging from 1 mgm. to 50 Gms.

A set of avoirdupois weights usually includes weights ranging from $\frac{1}{8}$ oz. to 2 lbs.

Nothing is gained by having a set of apothecary weights for quantities larger than one ounce, since such quantities are very seldom called for, and the weights may easily be confused with the avoirdupois weights.

Weights are in nearly all instances sold separately from the balances or scales.

Technique for Weighing.—A scale or balance should be placed on a flat, level counter, stand or shelf as free as possible from vibration and out of the range of drafts, air currents, etc.: weighing may be done more rapidly as well as more accurately when these precautions are observed.

Before weighing, see that the beam swings freely when released from the locking or arresting mechanism, that the instrument is in balance, i.e. swings as much on one side as on the other, and that the pans are empty. Very slight changes in position may throw the instrument out of balance due to unevenness of the table surface, so that the leveling or adjusting screws in the base should be changed to bring it back to horizontal and to bring the pointer to zero when the beam comes to rest after oscillating.

It is good technique before making a weighing, except of a liquid, to place a clean piece of paper (small powder paper) on each pan and then bring the instrument into balance by adding small pieces of paper to the lighter side. Since it is the exception to find two pieces of paper even when the same size, exactly the same weight, this custom insures getting the instrument into balance each time before weighing. Both pans should be cleared of the paper and the weights put in place, when the weighing is completed.

In prescription compounding, weighings of definitely named quantities are wanted and the routine of this weighing differs somewhat from weighing in chemical analysis, where the weighing is done to learn the weight of certain selected portions or quantities.

In compounding, after placing paper on the pan and getting the instrument in balance and again locked with the pan at rest, the weights wanted are selected and placed on one pan: read these weights and compare with the prescription, both before and after placing on the pan; the material wanted is taken from the bulk container with a spatula and placed on the other pan: when it is thought that

the desired quantity is on the pan, release the beam and let it oscillate: add or remove material as needed to bring the instrument into balance.

The pans and beam should be locked with the arresting mechanism each time before putting any weight or material on the pans; this protects the knife-edges from sudden jars and also makes it possible to weigh more rapidly.

Remove the paper containing the material from the pan and then take the weights from the other pan, again reading them and comparing with the written prescription.

The pans, beams, case and all parts of the balance, together with the weights, should be kept very clean. Correct and exact weighing is impossible on a dirty balance or with dirty or corroded weights. Clean weights, exactly correct, may readily lose or gain 5% to 10% if allowed to become dirty and corroded.

Weights should be cleaned with soap-suds and water and wiped dry immediately with soft towels.

Exact weighing is one of the most important foundation stones for the accuracy of practically all prescription compounding: too many safeguards cannot be thrown around it nor too many precautions be observed in this important part of the work of the prescription counter.

When not in use the beam and pans should be locked with the arresting mechanism, the pans be emptied of all weights or material, and the case or cover closed to protect the instrument from dust, moisture and corrosive fumes or gases.

Specific Gravity.—Since every kind of matter has both weight and volume, it often becomes of interest to find the relation or ratio between the

weight and the volume of a given sample, especially in work intended to show the identification or the purity of the sample.

The tabulated relationships between weight and volume units and standards are based on measurements of given quantities of pure water under known conditions of temperature and pressure, and hence it has become customary to determine the ratio between the weights of equal volumes of the sample and of water—calling this ratio specific gravity or specific weight—or to determine the ratio between the volumes of equal weights of the sample and of water—calling this ratio specific volume—rather than to make a direct comparison between the weight and the volume of the sample itself.

Problems in specific gravity or specific volume seldom, if ever, arise in connection with prescription writing or compounding, at least not in the United States, where liquids are prescribed and dispensed by volume and solids by weight.

Reference to the United States Pharmacopœia 1X is advised for directions for determining the specific gravity of drugs. The Pharmacopœia also gives the specific gravity of many drugs as a mark of identification or of purity.

Metric Measures of Volume.

		Abbrvtd.	Written
1 Milliliter	= 1/1000 of 1 Liter	Mil	1.
1 Cu. Cent.	= vol. of 1 Gm. of water	Cc.	1.
10 Mil	= 1 centiliter	cl.	10.
10 cl.	= 1 deciliter	dl.	100.
10 dl.	= 1 Liter	L.	1000.
1000 Mils (Cc.)	= 1 Liter	L.	1000.
10 L.	= 1 Dekaliter	Dl.	10000.
10 Dl.	= 1 Hectoliter	Hl.	100000.

As before noted, the unit Mil (Cc.) is the only one in this table commonly used in prescription compounding: the figures in the column headed "written" are read as Mils (Cc.), thus 10 Mils instead of 1 dl., or 1000 Mils instead of 1 L. In work where larger quantities are involved the unit Liter may be used, the decimal point moved three places to the left and the figures read as 10 L. instead of 1 Dl., etc. Equivalent English measures of volume are given on the following pages.

Apothecaries' Fluid Measure.

One minim of water is about equal to a drop a little less than $\frac{1}{5}$ inch in diameter; weighs approximately $\frac{95}{100}$ grain; abbreviated min.; symbol M.

		Ab.	Sym.	Writ.	Cu. in.
60 mins.	= 1 fluidrachm	fldr.	f̄5	f̄5i	.225
8 fldrs.	= 1 fluidounce	floz.	f̄3	f̄3i	1.804
4 flozs.	= 1 gill				
4 gills	= 1 pint				
16 flozs.	= 1 pint	pt.	O	Oi	28.9
2 pts.	= 1 quart	qt.		Oii	57.8
4 qts.	= 1 gallon				
8 pts.	= 1 gallon	gal.	C	Ci	231.

Gal.	Pt.	Floz.	Fldr.	M.	Domestic Equivalent
1	= 8	= 128	= 1024	= 61440	
	1	= 16	= 128	= 7680	= 2 tumblerfuls
		1	= 8	= 480	= 2 tablespoonfuls
			1	= 60	= 1 teaspoonful

Metric Weight.

		Abbrvtd.	Written
1 Milligram	= .001 Gram	mgm.	.001
10 mgm.	= 1 Centigram	cgm.	.010
10 cgm.	= 1 Decigram	dgm.	.100
10 dgm.	= 1 Gram	Gm.	1.
1000 Mgm.	= 1 Gm.	Gm.	1.
10 Gm.	= 1 Dekagram	Dgm.	10.
10 Dgm.	= 1 Hectogram	Hgm.	100.
10 Hgm.	= 1 Kilogram	K.	
1000 Gm.	= 1 Kilogram	K.	1000.
10 K.	= 1 Myriagram		100000.

As before noted, the units milligram and Gram are the only ones in this table commonly used in prescription compounding; the figures in the column headed "written" are read as milligrams when on the right hand side and as Grams when on the left hand side of the decimal point. In work where larger quantities are involved the unit Kilogram, or more commonly Kilo, may be used and the decimal point moved three places to the left and the figures read as 10 K. instead of 1 Myriagram or 10000 Grams. Equivalent English weights are given on the following pages.

Apothecaries' Weight.

1 grain is about equal to a drop of water a little less than $\frac{1}{5}$ inch in diameter: equivalent to $64 \frac{8}{10}$ mgm.; abbreviated gr.

20 grs.	= 1 scruple	sc.	ᵐ
3 sc.	= 1 dram	dr.	ʒ
60 grs.	= 1 dram	dr.	ʒ
8 dr.	= 1 apoth. or troy ounce	tr. oz.	ʒ
12 tr. oz.	= 1 apoth. or troy pound	tr. lb.	

lb.	tr. oz.	dr.	sc.	grs.
1	= 12	= 96	= 288	= 5760
	1	= 8	= 24	= 480
		1	= 3	= 60
			1	= 20

These units of weight are used in prescription compounding only and have no place in the ordinary trade transactions, buying and selling, in drugs. The unit scruple is obsolete in prescription writing and may well be allowed to be, since its symbol may easily be mistaken for that of dram, one scruple (20 grs.) and two scruples (40 grs.) weights are, however, included in nearly all sets of apothecaries' dram weights. Equivalent metric weights are given on the following pages.

Avoirdupois Weight.

The grain (gr.) in avoirdupois weight is the same as in apothecaries.

437½	grs.	=	1 ounce—oz.
16	ozs.	=	1 pound—lb.
2000	lbs.	=	1 ton

Avoirdupois weight is used in all the ordinary commercial transactions in drugs and, unless otherwise specified, these units and values are understood when ounces and pounds are referred to.

Equivalent metric weights are given on the following pages.

Approximate Measures.

- 1 drop = 1 minim = (1 grain distilled water 60°F.)
- 60 drops = fl. ʒ j
- 1 teaspoonful = fl. ʒ j
- 2 teaspoonfuls = fl. ʒ ji
- 4 teaspoonfuls = tablespoonful = fl. ʒ ss.
- 1 wineglassful = fl. ʒ ji
- 1 teacupful = fl. ʒ jv
- 1 tumbler = fl. ʒ vjii
- 1 pint = 1 lb. av.
- 2 pints = liter or Kilogram of water

One Meter	= 39.37	inches
One Liter	= 61.023177953	cubic inches
One Gram	= 15.43235639	grains
One Cubic Centimeter	= 16.23	minims
One Milligram	= 10/648	grain
One Liter	= 33.815	U. S. fl. ozs.
One Liter	= 35.235	av. oz., water 62°F.
One Kilogram	= 35.23 +	avoirdupois ounces
One Kilogram	= 32.15 +	troy ounces

Meter = 39.37 inches, dm. = .1 meter.

∴ dm. = 3.937 inches.

Liter = 1 cubic dm., cubic dm. = 1 dm.³. 1 dm.³
= 3.937 inches³ = 3.937 × 3.937 × 3.937 = 61.023177953
cubic inches.

∴ 1 liter or cubic dm. = 61.023 + cubic inches.

1 U. S. wine gallon = 231 cubic inches.

1 liter (1000 Cc.) = 61.023 + cubic inches.

231 (the number cu. in. in 1 gallon) divided by
61.023 + (the number cu. in. in 1 liter) = 3.785434.

∴ U. S. wine gallon = 3.785434 liters; 1 L = 1000
Cc., 3.785434 L = 3.785434 × 1000 Cc. = 3785.434 Cc.

∴ 1 U. S. wine gallon = 3785.434 Cc.

1 U. S. wine gallon = 128 apothecaries' fluidounces
∴ 128 fluidounces = 3785.434 Cc., and if 128 = 3785.-
434, one Ap. fluidounce = 1/128 of 3785.434 Cc. =
29.573 + Cc.

∴ 1 Apoth. fl. oz. = 29.57 + Cc.

1 fl. ounce = 29.573 Cc. = 480 minims. If 29.573 Cc. = 480 minims, one Cc. = $1/29.573$ of 480 m. = $480/29.573$ m. = 16.23 m.

∴ 1 Cc. = 16.23 minims.

1 kilogram = 15432.35639 gr.

1 Gram = $1/1000$ of 1 Kgm.

∴ 1 Gm. = 15.432 + grains.

1 apothecary ounce = 480 gr.

1 Gm. = 15.432 gr.

$480 \div 15.432 = 31.10 +$

∴ 31.10 Gm. = 1 Ap. oz., for 15.432 gr. = 1 Gm.

1 grain = $1/15.432$ Gm.

$480 \text{ gr.} = 480 \times 1/15.432 = 480/15.432 = 31.10 +$
Gm.

1 Av. ounce = 437.5 grains.

15.432 gr. = 1 Gm.

1 gr. = $1/15.432$ Gm.

$437.5 \text{ gr.} = 437.5 \times 1/15.432 \text{ Gm.} = 437.5/15.432$
Gm. = 28.349 + Gm.

∴ 1 Av. oz. = 28.35 Gm.

1 Kgm. = 15432.35639 gr.

1 Av. pound = 7000 gr.

$15432.35639 \div 7000 = 2.2 +$

∴ 1 Kgm. = 2.2 + Av. pounds.

1 gallon = 8 pints = 3785.432 Cc.

1 pint = $1/8$ of 3785.434 Cc. = 473.18 Cc.

∴ 1 Ap. pint = 473.18 Cc.

1 gallon = 8 pints = 3.785433 Liters.

If 3.785434 L. = 8 pints

1 L. = $1/3.785434$ of 8 pints = $8/3.78543 = 2.11$ pints.

∴ 1 L. = 2.11 wine or U. S. or Apoth. pints.

To Convert Metric Weights or Measures Into Those in Ordinary Use.

Rule.—Multiply the metric quantities by the corresponding equivalents. **Ex.**—The equivalent of one meter is 39.37 + inches, and five meters = 196.85 inches: $39.37 \times 5 = 196.85$.

To convert:

Meters	into inches multiply by	39.37
Centimeters	“ “ “ “	0.3937
Millimeters	“ “ “ “	0.03937

As one liter, or 1000 Cc., is equal to 33.8149 + fluidounces, or 35.235 + imperial fluidounces, to convert:

Liters into fluidounces multiply by 33.815
Cubic centimeters into fluidounces multiply by 0.0338

Liters into pints multiply by 2.11

Liters into imperial pints multiply by 1.7617

Liters into imperial gallons multiply by 0.2202.

Cubic centimeters into imperial fluidounces multiply by 0.352

As one gram is equal to 15.432 + grains, or .035235 avoirdupois ounce, or .03215 troy ounce, to convert:

Grams	into grains	multiply by 15.432
Centigrams	“ “	“ “ 0.15432
Milligrams	“ “	“ “ 0.015432
Kilograms	“ avoirdupois ounces	“ “ 35.235
Grams	“ avoirdupois ounces	“ “ .035235
Kilograms	“ avoirdupois pounds	“ “ 2.2
Kilograms	“ troy ounces	“ “ 32.1507
Grams	“ troy ounces	“ “ .03215

To Convert the Weights and Measures in Ordinary Use into Metric Weights and Measures.

RULE.—Multiply the quantity by the corresponding metric equivalent.

As one inch is equal to 0.0254 meter, one fluid-ounce to 29.572 cubic centimeters, one imperial fluidounce to 28.3807 cubic centimeters, one grain to 0.0648 gram, one avoirdupois ounce to 28.3495 grams and one troy ounce to 31.1035 grams. To convert:

Inches	into meters	multiply by 0.0254
Inches	“ centimeters	“ “ 2.5399
Inches	“ millimeters	“ “ 25.3997
Pints	“ liters	“ “ 0.4731
Fluidounces	“ cubic centimeters	“ “ 29.572
Imperial pints	“ liters	“ “ 0.5776
Imperial gallons	“ liters	“ “ 4.5409
Imperial fluidounces	“ cubic centimeters	“ “ 28.3807
Grains	“ grams	“ “ 0.0648
Grains	“ centigrams	“ “ 6.4799
Grains	“ milligrams	“ “ 64.799
Avoirdupois ounces	“ kilograms	“ “ 0.02835
Avoirdupois ounces	“ grams	“ “ 28.3495
Avoirdupois pounds	“ kilograms	“ “ 0.4536
Troy ounces	“ kilograms	“ “ 0.0311
Troy ounces	“ grams	“ “ 31.1035

TABLE OF METRIC MEASURE WITH COR- RESPONDING EQUIVALENTS IN FLUID OUNCES AND FRACTIONS.

Cc.	Fluid ounces and fractions.	Cc.	Fluid ounces and fractions.
2000.	67.628	1035.080	35.
1900.	64.246	1005.506	34.
1892.7	64.	1000.	33.814
1800.	60.865	975.932	33.
1774.4	60.	950.	32.123
1700.	57.484	946.358	32.
1600.	54.102	916.875	31.
1500.	50.721	900.	30.432
1478.685	50.	887.211	30.
1449.111	49.	857.637	29.
1419.538	48.	850.	28.742
1400.	47.339	828.064	28.
1389.964	47.	800.	27.051
1360.390	46.	798.490	27.
1330.817	45.	768.916	26.
1301.243	44.	750.	25.360
1300.	43.958	739.343	25.
1271.669	43.	709.769	24.
1242.095	42.	700.	23.670
1212.522	41.	680.195	23.
1200.	40.577	650.621	22.
1182.948	40.	621.048	21.
1153.374	39.	600.	20.288
1123.801	38.	591.427	20.
1100.	37.195	561.900	19.
1094.227	37.	550.	18.598
1064.653	36.	532.327	18.

TABLE OF METRIC WEIGHTS EQUIVA.
 LENT TO, FROM $\frac{9}{10}$ GRAIN DOWN
 TO $\frac{1}{100}$ GRAIN.

Gm.	gr.	Gm.	gr.
0.058	$\frac{10}{100}$	0.008	$\frac{8}{100}$
0.057	$\frac{9}{100}$	0.007	$\frac{7}{100}$
0.056	$\frac{8}{100}$	0.0065	$\frac{65}{100}$
0.055	$\frac{55}{100}$	0.0054	$\frac{54}{100}$
0.054	$\frac{54}{100}$	0.0042	$\frac{42}{100}$
0.052	$\frac{52}{100}$	0.0040	$\frac{40}{100}$
0.049	$\frac{49}{100}$	0.0036	$\frac{36}{100}$
0.045	$\frac{45}{100}$	0.0032	$\frac{32}{100}$
0.043	$\frac{43}{100}$	0.0027	$\frac{27}{100}$
0.040	$\frac{40}{100}$	0.0026	$\frac{26}{100}$
0.039	$\frac{39}{100}$	0.0022	$\frac{22}{100}$
0.036	$\frac{36}{100}$	0.0020	$\frac{20}{100}$
0.032	$\frac{32}{100}$	0.0018	$\frac{18}{100}$
0.028	$\frac{28}{100}$	0.0016	$\frac{16}{100}$
0.026	$\frac{26}{100}$	0.00135	$\frac{135}{100}$
0.022	$\frac{22}{100}$	0.00129	$\frac{129}{100}$
0.020	$\frac{20}{100}$	0.00108	$\frac{108}{100}$
0.016	$\frac{16}{100}$	0.00101	$\frac{101}{100}$
0.013	$\frac{13}{100}$	0.00090	$\frac{90}{100}$
0.012	$\frac{12}{100}$	0.00081	$\frac{81}{100}$
0.011	$\frac{11}{100}$	0.00065	$\frac{65}{100}$
0.009	$\frac{9}{100}$		

TABLE OF METRIC MEASURE WITH EQUIVALENTS IN MINIMS.

Cc.	Minims.	Cc.	Minims.
31.	503.1	19.099.	310.
30.805.	500.	19.	308.4
30.190.	490.	18.483.	300.
30.	486.9	18.	292.2
29.573.	480.	17.867.	290.
29.	470.7	17.251.	280.
28.958.	470.	17.	275.9
28.341.	460.	16.635.	270.
28.	454.5	16.019.	260.
27.725.	450.	16.	259.7
27.109.	440.	15.403.	250.
27.	438.2	15.	243.4
26.493.	430.	14.787.	240.
26.	422.0	14.171.	230.
25.877.	420.	14.	227.2
25.261.	410.	13.555.	220.
25.	405.8	13.	211.0
24.645.	400.	12.938.	210.
24.029.	390.	12.322.	200.
24.	389.5	12.	194.8
23.413.	380.	11.706.	190.
23.	373.3	11.090.	180.
22.796.	370.	11.	178.5
22.180.	360.	10.474.	170.
22.	357.1	10.	162.3
21.563.	350.	9.858.	160.
21.	340.8	9.242.	150.
20.948.	340.	9.	146.1
20.332.	330.	8.626.	140.
20.	324.6	8.	129.8
19.716.	320.	7.393.	120.

Cc.	Minims.
7.	113.6
6.161	100.
5.545	90.
5.	81.2
4.929	80.
4.313	70.
4.	64.9
3.697	60.
3.081	50.
3.019	49.
3.	48.7
2.957	48.
2.896	47.
2.834	46.
2.773	45.
2.711	44.
2.649	43.
2.588	42.
2.526	41.
2.403	39.
2.341	38.
2.280	37.
2.218	36.
2.156	35.
2.095	34.
2.033	33.
2.	32.46
1.972	32.
1.910	31.
1.848	30.
1.787	29.
1.725	28.

Cc.	Minims.
1.664	27.
1.602	26.
1.504	25.
1.5	24.4
1.479	24.
1.417	23.
1.355	22.
1.25	20.3
1.232	20.
1.171	19.
1.109	18.
1.047	17.
1.	16.23
0.986	16.
0.924	15.
0.863	14.
0.801	13.
0.75	12.2
0.739	12.
0.678	11.
0.616	10.
0.555	9.
0.5	8.1
0.493	8.
0.431	7.
0.370	6.
0.308	5.
0.246	4.
0.185	3.
0.123	2.
0.06161	1.

PROBLEMS IN PRESCRIPTION WRITING

What is the total quantity of each ingredient required for 32 doses, each one teaspoonful (4 Mils—Cc.—or 1 fldr.), of the following mixture:

	English	Metric
Fldest. Cascara Sagrada	mins. x	.75
Tinct. Nux Vomica	mins. ii	.15
Chloroform	mims $\frac{1}{4}$	.015
Essence Pepsin, enough to make	fldr. i	4.

Multiplying the quantities given above in the English system by 32, the total number of doses wanted, the following figures result:

Fldest. Cascara Sagrada	mins. 320
Tinct. Nux Vomica	mins. 64
Chloroform	mins. 8
Essence Pepsin enough to make	fldr. 32

These results should be expressed in the largest units permissible and the figures changed accordingly: for the first three items, inspection shows that none equal 480 mins. (= 1 floz.), and hence these should not be changed to flozs.: the first two items exceed 60 mins. (1 fldr.), and hence may be changed to fldrs.: 320 mins. (quantity wanted) $\div$ 60 mins. (1 fldr.) = 5 20 60 or 5 fldrs.—20 mins.,

and on prescriptions written as $\text{f}\overline{\text{v}}\text{—mins. xx: 64 mins. (quantity wanted)} \div 60 \text{ mins. (1 fldr.)} = 1 \frac{4}{60}$ or 1 fldr.—4 mins., written as $\text{f}\overline{\text{v}}\text{i—mins. iv: inspection shows that the third item is smaller than the next largest unit and hence should remain as it is, mins. 8 or m viii; the fourth quantity, 32 fldrs., is larger than one fluidounce (8 fldrs.) and hence should be changed to this larger denomination; 32 fldrs. (quantity wanted)} \div 8 \text{ fldrs. (1 floz.)} = 4 \text{ flozs., written on prescriptions as f}\overline{\text{v}}\text{iv.}$

The quantities given in the metric system when multiplied by 32 yield the following figures:

Fldext Cascara Sagrada	24.
Tinct. Nux Vomica	4.8
Chloroform	.480
Essence Pepsin enough to make	128.

Both before multiplying by 32 and after, the quantities as written are read as Mils (Cc.) and it is not customary to change to units of a larger denomination.

How much each of the first two ingredients is given in one dose of the following mixture if each dose is one teaspoonful (1 fldr.—4 Mils, Cc.)?

Potassium Bromide	$\overline{\text{v}}\text{i}$	30.
Fldext. Lobelia	$\overline{\text{v}}\text{i}$	4.5
Peppermint Water enough to make	$\overline{\text{v}}\text{vi}$	180.

If each dose be 1 fldr. (1 teaspoonful) and there are 8 fldrs. in 1 floz., in 6 flozs. there are $6 \times 8 = 48$ fldrs., and hence the total quantity contains 48 doses. The total English quantities of each ingredient as given should therefore be divided by 48 to obtain the quantity in each dose or $\frac{1}{48}$ th of the total: before doing this, the quantities as written should be reduced to their lowest denominations: reduced

to grains and minims the first two ingredients are as follows:

Potassium Bromide	grs. 480
Fldext. Lobelia	mins. 60

Dividing these figures by 48, give the following:

Potassium Bromide	grs. 10
Fldext. Lobelia	mins. $1\frac{1}{4}$

If one dose of the mixture as written in the metric system is 4 Mils (Cc.) (1 teaspoonful), then the total quantity, 180 Mils, contains as many doses as 4 is contained in 180 or 45 doses of 4 Mils each.

Dividing the metric quantities written after the first two ingredients by 45 the following figures result:

Potassium Bromide	.666
Fldext. Lobelia	.1

and it is customary to read these as Potassium Bromide 666 mgm. (Potassium Bromide being a solid) and Fldext. Lobelia $1/10$ Mil (Cc.) (this latter being a liquid).

How much of each ingredient is required for 24 powders, each to contain:

	Metric	English
Bismuth Subnitrate	1.	15 grs.
Salol	.5	$7\frac{1}{2}$ grs.
Pancreatin	.2	3 grs.

Multiplying each of the quantities given by 24, the following quantities result:

	Metric	English
Bismuth Subnitrate	24.	360 grs.
Salol	12.	180 grs.
Pancreatin	4.800	72 grs.

The quantities stated in the metric system may stand as written above, but the quantities named in

the English system are usually written in terms of the largest units permissible, and the above should be changed as follows: inspection shows that none of these quantities are as much as 480 grains or 1 tr. oz., and hence they should not be reduced to tr. ozs., but since they are larger than 60 grs. (1 dr.), they should be changed to drams; 360 grs. (quantity wanted) $\div$ 60 grs. (1 dr.) = 6 drs.; instead of writing 360 grs. this should be written dr. 6 or, on prescriptions, ̄vi : 180 grs. (quantity wanted) $\div$ 60 grs. (1 dr.) = 3 drs.; instead of writing 180 grs., this should be written drs. 3 or ̄iii : 72 grs. (quantity wanted) $\div$ 60 grs. (1 dr.) = 1 dr., 12 grs., and on prescriptions would be written ̄i —grs. xii.

How much is given in each dose, if a mixture containing the following is given in 20 doses:

Acetanilid	5.	̄i —grs. xv
Caffeine	.3	grs. v
Sodium Salicylate	10.	̄iiss

Dividing each of the quantities in the metric system by 20, the following results are obtained:

Acetanilid	.250
Caffeine	.015
Sod. Salicylate	.500

and these are most conveniently read as,

acetanilid, 250 mgm.; caffeine, 15 mgm.;
sodium salicylate, 500 mgm. or $\frac{1}{2}$ Gm.

The quantities in the English system should be reduced to grs. before dividing by 20: when reduced the formula is,

Acetanilid	75 grs.
Caffeine	5 grs.
Sod. Salicylate	150 grs.

Dividing each of these quantities by 20, the following results are obtained:

Acetanilid	3¾ grs.
Caffeine	¼ gr.
Sodium Salicylate	7½ grs.

How much of each ingredient is needed for 15 capsules each to contain.

	Metric	English
Aloin	.015	gr. ¼
Ext. Be'ladonna	.005	gr. 1/12
Ext. Cascara Sagrada	.030	gr. ½
Strychnine Sulphate	.0005	gr. 1/120

Multiplying each of the above by 15, the results are,

	Metric	English
Aloin	.225	grs. 3¾
Ext. Belladonna	.075	grs. 1¼
Ext. Cascara Sagrada	.450	grs. 7½
Strychnine Sulphate	.0075	gr. 15/120

The metric quantities in the problems above are not exactly the equivalents of the English system quantities given.

How much Silver Nitrate is required in making 30 Mils (Cc.) of a 5% solution?

In pharmaceutical compounding, a percentage solution such as the above is figured on a weight to volume basis and this volume—30 Mils—is considered to have the same weight as the same volume of pure water, which is 30 Gms. 5% is another way of writing 5/100ths; $30 \text{ Gms.} \div 100 = 30/100 \text{ Gm.}$ (1/100 or 1%); $30/100 \text{ Gm.} \times 5 = 150/100 \text{ Gms.} = 1.50 \text{ Gms.}$ Hence, 1.50 Gms. of Silver Nitrate are

required in making 30 Mils of a 5% solution Silver Nitrate.

How much Atropine Sulphate is contained in $\frac{1}{2}$ floz. of a 1% solution? Considering this solution, weight for volume, as above, the weight of $\frac{1}{2}$ floz. is first to be found; one floz. of pure water weighs 456 grs.: $456 \times \frac{1}{2} = 456/2 = 228$ grs., weight of $\frac{1}{2}$ floz. of pure water. One per cent or 1% or 1/100th of 228 grs. is $228 \text{ grs.} \div 100 = 228/100 \text{ grs.} = 2 \frac{28}{100}$ grs. is required for $\frac{1}{2}$ floz. of 1% solution of Atropine Sulphate.

Please read again the paragraphs on Dosage Calculations in the preceeding chapter.

R

Tinct Nuc. vomitor

$\mathfrak{z}\overline{\text{ss}}$

grue Rhe $\mathfrak{z}\overline{\text{iii}}$

grue Chb Compous.
ad $\mathfrak{z}\overline{\text{ss}}$

℥. $\mathfrak{z}\overline{\text{ss}}$ every 4 hours
in water

Sam

No. 13 Is read:

R	Tinct. Nuc. Vom.	$\mathfrak{z}\overline{\text{i}}$.
	Tinct. Rhei.	$\mathfrak{z}\overline{\text{iii}}$.
	Tinct. Cinch. Co. ad.	$\mathfrak{z}\overline{\text{i}}$.
M	S. $\mathfrak{z}\overline{\text{ss}}$ every four hours in water.	

~~R~~
 Strych Sal $\text{R} \frac{\text{ii}}{\text{i}}$
 Soda Arsen $\text{ii} \frac{\text{ii}}{\text{i}}$
 Potas Carb $\text{gr} \frac{\text{ii}}{\text{i}}$
 Hydrag Buhl $\text{gr} \frac{\text{ii}}{\text{i}}$
 Chlor Sulph $\text{gr} \frac{\text{ii}}{\text{i}}$
 M. S. S. Teaspoonful after m

Prescription No. 16 is easily read in spite of the poor writing, but the pharmacist will see at a glance that the prescription is incompatible.

The sodium arseniate would be converted into potassium arsenate with the simultaneous formation of sodium carbonate. A second portion of the potassium carbonate abstracts from the strychnine salt its sulphuric acid, leaving the much less soluble strychnine alkaloid. Finally the mercuric chloride is decomposed by the potassium carbonate to give rise to mercuric oxide.

The medicine when prepared would be a six ounce mixture, containing potassium arsenate, pure strychnine alkaloid, oxide of mercury, and a reduced amount of potassium carbonate.

As this obviously is not the doctor's intention, he should be consulted and shown the incompatibility of the prescription.

R

Rad Rhu 3*B*.
 Fol Senna 3*I*
 Q. Bull add q.s. mft
 Infusum 3*III* adda
 Tinctura Natronatums.
 Ext. Licoricia 3*I*
 Sig. Symplic 3*II*
 Rha & Senna

Prescription No. 17 calls for half an ounce of rhubarb root, one ounce of senna leaves, with sufficient boiling water to make three ounces of infusion in which one ounce of rochelle salts and two drachms of extract of licorice are to be dissolved. The directions are one teaspoonful every three hours.

~~R~~
 Copab ℥ss
 Liquide Ext
 Powd Cassia. ʒss
 Aqua Bals. ʒm
 Ad Emulsion
 Sig. Take 3 times
 B.C.

Prescription No. 18 should be prepared as follows:

Place in a dry mortar six drachms of powdered gum arabic and as much of extract of licorice, thoroughly dry, and pour on the balsam of copaiba. Mix well, and add at one time twelve drachms of camphor water. Continue the stirring with the pestle till the mixture is thoroughly homogeneous, scraping now and then the side of the mortar and the pestle, so that no balsam can escape emulsion. Now add more camphor water by small portions at a time, and finally complete the three fluid ounces as prescribed.

P
X
Cal Permangan Gr XXX
Rt fil
gr / unj
1/4 hor

Prescription No. 19 calls for thirty grains of permanganate of potassium to be made into ten pills. The directions are one every four hours. For making these pills kaolin ointment is recommended. This is made from equal parts of petrolatum, paraffin and kaolin; the first two constituents being melted together, then kaolin added and stirred in until cool. It is said to be the only pill-mass which has been successfully used with potassium permanganate.

R Ergotin Gr viii
Olum. Kew DS
in fl Sup No viii
Fig One as directed

Prescription No. 20 calls for eight grains of ergo-
 tine and a sufficient quantity of a cacao butter to
 make eight suppositories.

Reps.

Chini. Sulfh. gr TK

Amst. Sulfh. gr F

Mgt Tal dos. No
XXX

Capsules.

One 3 times a day after
meals as directed.

Prescription No. 21 is very well written, and would give no trouble provided one is acquainted with the two Latin words, "tales doses," meaning of such doses. In this prescription the quantities of the ingredients for one dose are given and the pharmacist instructed to make thirty such doses and put them in capsules.

(50) Euonymin gr. xxxv
 Juglandin gr. xlv
 Leptandrin gr. xl
 Podophyllin gr. $\overline{iiij}$
 Oli Menth. pip. gtt. xx
 Pulv. Cardamomi sem.
 Pulv. anisi sem. ā ā gr. x
 Ext. Hyoscyam. q. s.
 Ft. capsules no. l.

No. 22 Is a combination of favorite eclectic remedies. It reads as follows:

℞. Euonymin	gr. xxxv.
Juglandin	gr. xlv.
Leptandrin	gr. xl.
Podophyllin	gr. iiij.
Oli. menthæ pip.	gtt. xx.
Pulv. Anisi semen	} āā gr. x.
Pulv. Cardamomi semen ..	
Ext. Hyoscyami	q. s.
(Misce) Ft. Capsul.	No. L.

The fault with the above prescription is with the last item. Ext. Hyoscyamus is too potent a drug to prescribe or dispense so indiscriminately.

11 18/3888

g
p

Alum. pow: gr XII

Aq. dest: 3 5 p

Glycerini 3 p

Cocaine gr V

des. for Inhalation

No. 10 calls for powdered alum and cocaine, to be dissolved in a mixture of one-half ounce glycerine and $5\frac{1}{2}$ ounces of water. Cocaine (alkaloid) is soluble in 700 parts water; part here would remain undissolved. If attempt is made to dissolve by heat, double decomposition follows, complicated reactions take place, white oily globules settle to the bottom, while a flocculent precipitate of *aluminum-hydroxide* remains suspended in or floats on the surface of the liquid. The solution should be filtered. "16 to 1" the prescriber meant to write for *hydrochloride* of cocaine, but he did not, and a druggist should not take the liberty of changing a prescription unless permitted by the physician.

R

Eut. Ergot. 10

Tr: capsul 30.

Take two at bedtime
every night

Prescription No. 2 is an example of a correctly written prescription, by the metric system; it was written about 10 years ago by one of the most prominent physicians (now deceased) of Chicago, in his day; it was compounded by the writer for the doctor's own use. Comment is unnecessary; we might, however, say that if one of the *busiest* physicians can find time to write his orders clearly, and carefully, some who have time to spare, could employ it to good advantage in this direction, and at the same time assist the druggist, who often finds it very embarrassing, as well as a great inconvenience, to spend ten or twenty minutes deciphering hieroglyphics.

<i>℞</i>	<i>Gm. cc</i>
<i>Strych. Sulph</i>	<i>06</i>
<i>Liq. Acide Arseniose</i>	<i>2 60</i>
<i>Sr. Ferr. Chloridi.</i>	<i>6</i>
<i>Acide Hydrochlor.</i>	<i>6</i>
<i>Glycerin.</i>	<i>30</i>
<i>Syr. Simp. q.s ad</i>	<i>120</i>
<i>Mixt. = Take a teaspoonful in</i>	
<i>Date water (3) three times daily.</i>	

No. 3 also, shows care, neatness, and ability to write a prescription that is correct in every way, as easily as to be careless and slovenly; it is a fair sample of the great number written during many years of practice by this physician; he prefers to use the metric system.

R

Kal. jodat 30, 00
Aqua fontis 100, 00
Syrup. Sarsaparilla
 70, 00
D. S. Teaspoonful
twice
7/18/0

No. 7 written hastily, but the experienced drug-
 gist has no difficulty in reading it.

	Grams.
R. Kalium Jodatum.....	30.00
Aqua fontis.....	100.00
Syrup Sarsaparillæ.....	70.00
D. S. Teaspoonful twice daily.	

Tint. Ferri Chloridi 3v
 Potassii Chloratis 3j
 Tint. Belladonæ gtt. v
 Glycerinum 3ss
 Syr. Glycyrrhizæ 3jss
 Aqua Cinnamomi ad q. s. 3iv
 only 1

Give a teaspoonful in
 water every four hours

No. 6 is written negligently, the prescriber's time being limited: there is also a slight incompatibility, viz.: Tr. Ferri Chloridi, with Syr. Glycyrrh. In full the prescription reads:

R. Tint. Ferri Chloridi 3 v.
 Potassii Chloratis..... 3 j
 Tint. Belladonæ..... gtt. v
 Glycerinum..... ss.
 Syr. Glycyrrhizæ..... jss.
 Aqua Cinnamomi ad q. s. 3 iv.

M. et Sig. Give a teaspoonful in water every four hours.

R Potass. Sesquicarb 3ss
 Hydrastia Mur. gr. xv
 Tannic acid gr. v
 Morph. Sulph M. j
 Aq. ros 3iv
 Berberine Hydrochlorate

No. 5 calls for:

Potassii Sesqui-carbonatis.....	3 ss.
Hydrastia Muriate.....	gr. xv.
Tannic Acid.....	gr. v.
Morph. Sulph.....	gr. j.
Aqua rosæ.....	3iv.

M. et Sig. External use as directed.

The second article mentioned was intended for Berberine Hydrochlorate, but as this article was in trade under the wrong name when the above prescription was written, the prescription was correct.

R To Luce 3i
 Cyprae 3i
 M.S.A.
 Sig. As direct.
 A.M.

Prescription No. 14 is one that requires particular manipulation in compounding, in order to secure a thorough admixture of the ingredients. The tincture of guaiac should be placed in a dry mortar and by adding the water, a few drops at a time, with constant trituration, a perfect solution is retained.

R Infus: fl digitalis.
 (F) 3v
 Ammon . ammoniat. Lys.
 Spirit. æther. antisept.
 Tinct. scillæ. grs
 Syr sennæ
 — morph. 3℥.
 Misce 3 horas
 1℥. 1℥.

Prescription No. 15 shows very poor writing and abbreviating; it is generally read as follows:

R Infusi (foliorum?) digitalis..... 3v.
 Ammonii chloridi (depuratum) ..
 Spiritus ætheris nitrosi..... aa3ij.
 Antimonii tartratis..... gr. j.
 Syr. Scillæ.....
 Syrupi morphinæ..... aa3ss.
 Misce.....

Sig. One teaspoonful every three hours.

However, many pharmacists contend that the fifth ingredient is syrup of senna, instead of syrup of squills. Unfortunately, we were unable to consult the writer.

COMPOUNDING IN GENERAL OF Physicians' Prescriptions, Recipes, Galenical and Extemporaneous Preparations.

A *prescription* is the physician's order or requisition upon the pharmacist to dispense, in a certain manner, some drug, preparation or extempore formula with directions to the patient for use or administration. If the prescription be for one single drug or preparation it is necessary only to weigh or measure that drug or preparation, enclose in the proper container, attach the proper directions and deliver it, observing necessary precautions as to dose, etc., etc.

If, however, it be a formula, then it becomes necessary at once to prepare or compound the prescription first, and to be able to do so *always properly and expeditiously* is the *goal* of every good pharmacist's ambition. Ability to accomplish that requires a patient study in detail of all the different classes of pharmacopœial preparations, supplemented with a considerable knowledge of the chemical and physical properties of drugs.

Just as with the study of any other subject, *good results* can be had more quickly and easily accordingly as we analyze and classify each separate part composing the whole subject.

A *definite* and *perfect* classification of extemporaneous pharmaceutical preparations would be *very difficult* indeed. To begin, we may say that a

medicine is a *material substance* administered internally or applied to the surface of the body to relieve pain, prevent disease or restore health impaired. We, then, would have medicines of two classes as to mode of administration:

- { 1. Systemic—internal
- { 2. Topical—external,

but some medicines topically applied are nevertheless absorbed into the blood and become *ipso facto* systemic medicines.

As to origin or chemical nature we have:

- { 1. Organic { animal
- { vegetable
- { 2. Inorganic—mineral.

Organic preparations are sometimes called galenical preparations when no chemical process is required in preparing them. Many such preparations are *official*, that is, formulas and directions for their preparation, preservation and doses are given in the Pharmacopœia. Many others are given in pharmacopœias of other countries, while many more are not given in any pharmacopœia, yet nevertheless are *officinal*; that means that they are so generally used in certain parts of the country as to warrant druggists keeping them in stock already made up; but by far the greater number of prescriptions call for *extempore* preparations or *mixtures* of different drugs or preparations in proportions deemed most suitable for the *special occasion* for which the prescription was written, and in small amounts. Many times, small amounts are prescribed with the intention of varying the prescription from time to time as the patient's condition varies.

It is evident, therefore, that another basis of classification must be chosen and as to form or consistence we have

Solids for internal use.

Powders: Simple—Compound.

Bulk.

Species.

Dusting.

Triturations.

Divided doses:

Powders, Papers, Charts

Cachets, Konseals, Wafers

Capsules.

Effervescent powders, granules, tablets.

Tablets—compressed, coated.

Lozenges, Troches, Pastilles.

Masses.

Confections, Conserves, Electuaries.

Jellies.

Pills, Granules, Parvules, Boluses, Coated.

Solids for external use.

Ointments, Cerates, Inunctions, Mulls, Petroxolines, Pastes, Salves.

Oleates.

Pencils.

Glycogelatines.

Suppositories—Rectal, Vaginal, Nasal.

Plasters.

Poultices.

Poison tablets.

Gauzes, etc.

For classification of Liquids, see page 163.

The practice of interpreting quantities written after the names of solids in units of weight and if written after liquids, in units of volume or capacity, makes it important for physicians to know whether an article ordered is a solid or a liquid—especially if the prescription is not written in the metric system.

Solids not readily soluble in the ordinary solvents or vehicles are usually prescribed in the divided-dosage forms, tablets, pills, capsules, etc. The selection of diluents is largely controlled by the condition of the medicaments—solids being mixed with solids such as milk sugar and liquids with liquids such as simple elixir.

The names for many classes of preparations are almost self-explanatory in this respect; syrups, fluidextracts, waters, lotions, glyceroles, solutions are at once recognized as liquids, and pills, tablets, solid extracts, powdered extracts, powders, as solids.

Alkaloidal salts, salts of the metals, iron, bismuth, etc., and of the alkalies and alkaline and rare earths used in medicines are solids.

Practically all of the crude drugs derived from plants, except fatty and volatile oils, are solids.

It is desirable to observe each substance used as a medicinal agent and note whether it is ordinarily solid or liquid.

1. SOLID PREPARATIONS FOR INTERNAL USE:

a. Powders are: (1) *Simple*, if consisting of a single medicinal substance. (2) *Compound*, if consisting of more than one substance, and may be finely powdered or very coarse according to the manner in which they are to be used.

Insoluble substances and powders for external use (dusting powders) should be as finely powdered as possible always, since their effect is due partly to mechanical action depending upon a contact of the largest possible amount of surface of the particles with the tissues.

Dusting powders are usually intended to absorb, and dry the surfaces to which they are applied and it is well known that the finer the particles of powder the greater will be their absorbent powers. Powders to be dissolved before being administered are best dispensed in a somewhat coarse condition, since granular (e. i. No. 10 po.) substances dissolve more easily than fine powders.

In whatever size the particles of powder be, uniformity of size is a consideratum.

Compound powders should, of course, consist of drugs having as nearly as possible the same degree of fineness and, like simple powders, should be from very fine, if insoluble, to coarse or granular if to be dissolved before being administered.

Drugs and chemicals can be had in the market of any degree of fineness desired and if used in considerable quantity should be purchased of the desired fineness. Smaller amounts, however, may be prepared as desired by trituration in mortar and passing through a sieve of proper size mesh. Every prescription department should have a set of sieves of sizes prescribed by the Pharmacopœia and for some purposes even one or two of larger mesh.

Very seldom will the pharmacist find all the ingredients of a prescription of the same fineness; the coarser substances should be first reduced to powder of proper degree of fineness before mixing with remaining finely powdered substance, except when unnecessary.

Certain drugs, very potent in action, when prescribed in powder form are best dispensed with an inert diluent or "filler" to allow of very fine division of particles and principally to increase the bulk of powder to such extent as will enable a convenient and accurate division into more nearly definite doses (see triturations).

If all ingredients entering into the composition of a compound powder are of the same degree of fineness, or if two or more fine light powders are to be mixed, or if a fine *light* and fine *heavy* powder are to be mixed, then do not triturate in a mortar, but mix thoroughly by shaking in a capacious bottle or box or pass through a sieve, after stirring together with a spatula.

In using the mortar and pestle for mixing powders be careful to avoid triturating oxidizing agents with oxidizable substances or reducing agents (see page 109).

Also remember that certain crystalline substances containing a large amount of water of crystallization will not bear too *much pressure*; and that if triturated with other crystalline drugs the two may liquefy in that water of crystallization.

R. Camphoræ.....	1 gm.
Zinc-oxid.	10 "
Amyli.....	20 "
M. ft. pulv. scat. exhib.	

Powder the camphor very finely by means of a few drops of volatile liquid (alcohol, ether, chloro-

form, etc.), add the starch in small portions, mixing each well, then add the zinc oxide, stir well and pass through a fine sieve. Zinc oxide, camphor, resins, alkaloids, bismuth salts, ammoniated mercury and many other substances when triturated in a mortar tend to cake and adhere either to the pestle or mortar, hence in mixing powders containing them, pressure should not be used, but they should be passed through a sieve.

R. Plumbi Acetatis
Zinci Sulph.

Alumen āā 25 gm.

M. S. Poison.

The granulated or powdered salts may be taken, or if in crystalline condition, they should each be separately reduced to powder and mixed by stirring, but must not be triturated together because some of the water of crystallization will be set free and a double decomposition ensue, resulting in a wet, pasty mass.

R. Rhei Pulvis.

Magnesii Carbonas āā 5i

M. S. 3i cum aqua. p. r. n.

The magnesium carbonate, which usually occurs in cubes, may easily be reduced to fine powder by being rubbed through a sieve, when it should be mixed with the rhubarb and again passed through the sieve.

R. Potassii Chloras.

Sacchari Albi.

Acidi Tannici āā 10 gm.

M. S. 3i sol. c. aqua pro. garg.

Here is a strong oxidizing agent, chlorate of potash containing oxygen easily liberated and vegetable substances rich in carbon prone to combine

with it: if triturated with force or if struck between mortar and pestle the mixture might explode—hence it is very dangerous to mix by mortar and pestle method but should be mixed by stirring the ingredients separately pulverized, by means of a spatula.

(3) Powders are dispensed in bulk, if to be taken in large doses, either in a box or bottle.

(4) In papers, capsules, wafers, cachets or konseals if to be taken in small or divided doses. “Papers” (*chartulæ*—little papers) are prescribed when the physician wishes the doses to be divided; if the powder be not volatile, not deliquescent nor subject to ready deterioration, plain glazed white paper is used. On the other hand, a powder which would be affected by air in any manner deleterious to its medicinal effect or easy administration, then paraffined or waxed papers should be used. When an acid and an alkali carbonate or bicarbonate are to be mixed in water and given while effervescence is ensuing the alkaline powder is usually wrapped in blue paper and the acid in white and directions attached for their mixing.

Hard capsules are rod-like shells of gelatine of two parts fitted together, used to administer bitter, nauseous or otherwise objectionable medicines. Soft capsules are ovoid or egg-shaped shells of soft gelatine, i. e., gelatine with a small proportion of glycerine to render it pliable and more soluble. They are not practical for enclosing powders, but are a very useful contrivance for oils and certain fluids which will not dissolve them.

Capsules are of modern origin, prepared by machinery on an immense scale, but can not be *filled* satisfactorily by any machine or device yet *invented*. The filling of a hard gelatine capsule

with a dry powder is so simple that nowadays it is the first thing learned by the drug-store boy, but the hand of man is the only satisfactory "machine" complex enough to accomplish this simple feat properly.

Soft capsules have one end drawn out and terminating in a little teat which, just before the capsule is to be filled, is carefully cut off and melted in a water bath—the medicine is to be dropped into the soft capsule, care being taken that none gets upon the freshly cut surface of the capsule else it can not be sealed. A glass rod is dipped into the melted soft gelatine and dexterously drawn over the open mouth of the soft capsule, in such a manner that a film of gelatine will cover the opening which will be closed when the gelatine cools.

Wafers are small, thin sheets of unleavened rice-flour and gum-arabic bread cooked quickly upon polished plates. Rice-flour is largely starch; the starch, when heated, is altered, rendered partly soluble, and the water is dried out during the cooking. The sheets are then cut into pieces large enough to wrap and enclose a small dose of powder. A plate is wetted, the wafer placed upon it and the powder placed upon the center of the sheet and the edges folded upward over the powder; the whole is then swallowed with a draught of water.

Cachets or *konseals* are merely capsules of wafer material cooked in two concavo-convex sheets between which is placed the powder, after which the sheets are sealed together. To prepare them a device is required made specially for the purpose and consisting of a concave hopper, in which one sheet is placed, and in this half of the cachet the powder is placed, either with a spatula or a funnel. The other sheet is fitted into a concave hopper

attached to a handle, then passed over a moistened cloth to dampen the edges of the wafer sheet and then pressed upon the other sheet, thereby enclosing the powder. This form of administering powders is very neat and dainty, if the cachet has been properly prepared.

In dividing powders to be prepared as above care should be used that the doses be of proper and even amount—many pharmacists weigh each and every dose separately. Some weigh a sample or two and pattern others after them, while the great majority take the total mass and divide into total number of doses by aid of eyesight, an experienced hand and a good “balance-handled spatula.” There seems to be no good reason why an experienced pharmacist with a carefully trained hand can not nearly approach accuracy that way; but beginners should first learn to weigh accurately before they try to guess accurately.

While the quantity that is considered a dose of a drug may vary from time to time and in different individuals, this indefiniteness of dosage does not authorize either physician or pharmacist to add more uncertainty by being careless in naming the quantity to be taken, or slovenly in compounding and dispensing this quantity.

Observant customers may easily note the variation in carelessly divided powders and then base their opinion of the skill of the pharmacist on this one observation.

In general, when a vitreous, crystalline or a potent drug is to be mixed with other drugs or a diluent powder or filler, the potent, crystalline or vitreous drug should be first placed in a suitable mortar (roughened wedgwood), reduced to fine powder, an *equal amount* of diluent, filler or less

active drug added, trituration repeated, the whole loosened from sides of mortar by use of spatula and again an amount of drug or diluent equal to the combined powder already in the mortar, again triturating and repeating in that manner, thereby attaining the principal objects of uniformity of size and equal distribution of all the particles of the several constituents of the powder.

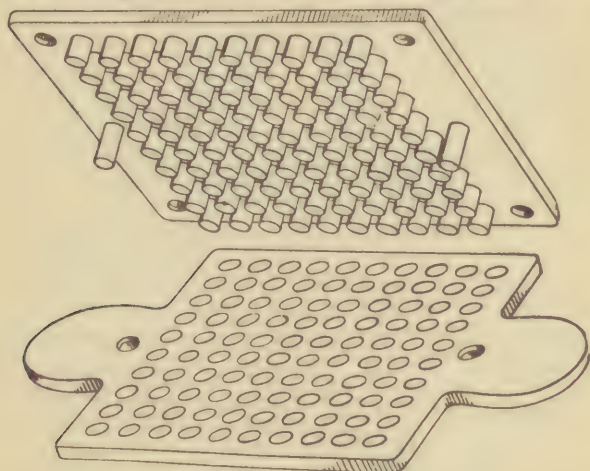
If a liquid is to be mixed with an insoluble powder, then the liquid is treated just as would be a potent drug. In some pharmacopœias are to be found a class of powders called "oil-sugars," consisting of a volatile oil and sugar. While not of very much importance as medicines they have some place, being carminative, slightly stimulant and pleasant flavors and are usually used as "fillers" with other powders.

(5) *Triturations* are powders consisting of one part potent drug and nine parts milk sugar, in which the drug is finely powdered and thoroughly triturated until uniformly distributed throughout the whole mass of milk sugar: above is the strength official in IX Dec. Rev. U. S. P., but many pharmacists keep in their prescription cases triturations of other proportions of potent drugs for convenience and accuracy in weighing, it being much less difficult to accurately weigh a moderately large amount than a very small amount. It will be found good practice to keep such drugs as strychnine, arsenic, calomel, atropine, morphine, etc., in form of trituration in definite strength and to weigh, say two grains of trituration instead of one-fifth grain of drug, etc. Other drugs, such as aconitine, colchicine, adrenalin, etc., one to ninety-nine, or whatever proportion is most convenient, yet which will not likely result in confusion. See Dosage Calculations.

R. Elaterinum..... .1 gm.
 Sacch. Lactis..... .9 "

M. S. Trituratio Elaterini.

The elaterin is mixed with 1 dgm. milk sugar reduced to powder and thoroughly triturated; 2 dgm. milk sugar is next added and again triturated; the remaining milk sugar may now be added and trituration continued until the elaterin is equally diffused throughout the whole mass of powder.



Tablet Triturate Mould.

From *triturations* of *varied* strengths are prepared *tablet triturations*, by varying the proportion so as to give the required amount of potent drug to each tablet and using sugar or sugar of milk, or a mixture of both (with possibly some other inert powder) enough to fill the mould.

Tablet triturations are prepared, then, by moulding a triturated powder into a flat, round disc or tablet,

the powder first having been moistened with a suitable inert volatile, non-solvent liquid.

The mould consists of two parts or plates, through one of which are a number of perforations, and into the other are fastened an equal number of punches so arranged that each punch fits a corresponding perforation; the perforated plate is of the desired thickness of the tablets. The powder is moistened just enough to cause the particles to be slightly coherent and with a spatula is pressed into the perforations in the plate, which has been put on a pill tile or smooth surface; then both sides are cleaned off smooth by the use of a spatula and this plate fitted over the plate with punches and pressed down until the tablets are removed. They may be allowed to remain on the pegs until dry, which will not be long, or may be carefully removed and dried otherwise; if too moist the tablets stick, if too dry they crumble. This is a very useful method of exhibiting divided doses of some substances, but is not suitable for any but potent drugs, not suitable for volatile drugs nor those with any tendency to change readily from effect of air or light.

Similar in form to the tablet triturate, but otherwise different, is a class of preparations of greater range of application and therefore of greater importance to the pharmacist of to-day, viz.: Compressed tablets.

℞. Arsenii trioxidi, grana unam.

Ft. t.t. No. L.

S. One p. p.

Weigh one grain of arsenic trioxide, reduce to powder, mix with one grain milk sugar and triturate until well mixed; add about two grains more of milk sugar and again triturate; continue the addition of increasing amounts of milk sugar until forty-nine

grains have been added alternately with thorough trituration; by that means each grain of powder will contain $\frac{1}{60}$ grain of arsenic. Next moisten with a few drops of water and rub until a slightly damp adherent powder results; now, by means of a smooth spatula, rub this moist powder into the perforated plate of the tablet triturate mould previously placed on a pill tile or smooth surface; if all perforations are not filled calculate by proportion the amount of milk sugar required to fill the mould and after removing the powder from the mould mix with the milk sugar and again rub into the perforations of the mould and by means of the punches on the other plate remove the tablets and allow to dry.

If too much water was used to moisten, the tablets will be too hard and if too little they will crumble—they should be just hard enough to fall upon the floor without breaking, but quickly go to pieces when dropped in water.

(6) **Species**, are a class of powder preparations consisting of coarsely ground, cut or bruised vegetable drug or drugs, or one or more such drugs and a *soluble* powder, and are intended to be used to prepare a tea, an infusion or a decoction; therefore care should be used to sift out or otherwise separate the fine powder and reject it, since a clear infusion can not result from the use of a fine vegetable powder.

If a soluble powder is to be mixed with the vegetable drug or drugs, then such drug or drugs should be dampened and the fine, soluble powder sifted on, when upon drying it will adhere; otherwise a uniform mixture could not result. Teas or species are still much used in some places, but none are official in the United States at present.

b. Compressed tablets. These are, as the name signifies, tablets made by compression with machines varying from the simplest hand machine, which will turn out a few tablets per hour, to the latest improved rotary machine which will compress as many as 120,000 tablets per hour.

Tablets are compressed from powders either simple or compound and either fine or coarse. For rapid work the powder must be prepared first; for slow work on a hand machine not so much care in preparing the powder need be taken.

The machines are quite varied in style of mechanism, but the principle is the same in all, namely, the subjection of a definite amount of dry powder to the effect of a definite pressure, this pressure being applied in a die between two punches so regulated that they approach each other to within a certain distance, thereby compressing each powder to a uniform size, and as the powder is fed into the die and leveled off one can readily see that if the powder be not uniform as to size of particles, then there would be more powder in the die one time than another and hence make tablets of unequal weight; therefore the necessity of having all the powder first reduced to "granules" of even size and dried.

If the substance be a crystalline chemical containing little water of crystallization all that is necessary is to pass it through a sieve just large enough in mesh to pass the particles; then a smaller sieve, through which the fine powder is passed and rejected, is used. A powder which will pass entirely through a No. 8 sieve, but not through a No. 12 is quite suitable, although very much finer, also much coarser may be used, depending upon size of tablet desired and nature of drug. If a fine powder or a

number of substances are to be compressed, then all should be rendered uniform or as nearly so as practicable and "granulated."

"Granulation" is the really important part of tablet making and success depends upon correlating several important considerations, such as size of tablet to be made, nature of the drug or mixture, as to solubility, adhesiveness, chemical properties and the effect of heat upon it while being dried. No man can *tell* just how to make a proper granulation, describing in detail so that an inexperienced person might be sure of success by following directions, but yet there are very important directions which are easily described and should be remembered and applied without difficulty. To begin, a non-adhesive substance *must* be rendered adhesive to a certain degree, and yet not too much so; for this purpose gums will be found available but objectionable.

A *very soluble* yet non-hygroscopic substance, which is adhesive, but yet which will permit quick disintegration, is the most suitable—a mixture of starch paste and cane sugar used in solution to moisten the dry powder will answer in many cases.

A tablet triturate is made by slightly moistening a fine powder with a non-solvent liquid and should be non-cohesive, but a granulation for a *compressed tablet* must be cohesive and moistened until a *stiff paste* results; then this paste is passed through a *coarse sieve* (Nos. 8, 10 or 12) by rubbing with spatula, paddle, the hand or suitable machinery. This paste should be stiff enough so that the particles will "stand up" and not run together again when it is spread upon paper, cloth or a suitable place to be *quickly dried*.

In drying, the smallest amount of heat sufficient to accomplish results should be the rule—some substances like salol will stand only a slight heat. All granulations should be dried away from contaminating influences of dust, dirt, noxious gases, etc. The moist granulate should not touch metal unless it be of such a nature as not to permit chemical reaction. If time be not too great an object the atmosphere will be sufficient to dry the powder without use of heat.

After this granulation is made and dried, then it must be passed through a sieve, slightly coarser, and the fine powder afterward separated by a finer sieve, as above described.

Some substances which require the addition of an adhesive agent to effect granulation, and the adhesive agent is used sparingly, and even some to which no adhesive agent was added before granulation are afterward found to be too adhesive to compress well, sticking to the machine and making it necessary to use a "lubricant" or dusting powder before feeding into the machine for compression; for this purpose a variety of agents are used—depending upon the nature of the drug. Ordinarily powdered starch added to the granular powder and properly distributed before feeding will be found sufficient—sometimes powdered talcum, sometimes boric acid is used. Even fats are used to prevent adhesion to dies and punches. This is either sprayed on the granular powder by means of a weak solution in ether or made into an emulsion and the emulsion used to moisten preparatory to granulation.

Substances which are apt to react chemically should not be combined in tablet form, unless the product of the reaction be desired. Both tablet triturates and compressed tablets may be coated

with sugar variously colored, but this is a more complicated process and is done by machinery only. Other coatings may be used the same as for pills, but are not common (see pill coating, page 132).

c. **Granular effervescing** powders, salts and tablets consist of a drug mixed with a dry, fruit acid, citric or tartaric or both combined, and a bicarbonate (usually soda) in molecular proportion or nearly so. They may be prepared by either of three methods:

(1.) Proper molecular proportions of the dry tartaric acid and sodium bicarbonate are moistened with absolute alcohol and granulated, as in granulating for compressed tablets.

(2.) The acid and bicarbonate separately moistened, granulated, dried and mixed, or

(3.) Better, on a small scale, by taking 208.5 gr. of crystallized citric acid, 150 gr. of tartaric acid and 425 gr. sodium bicarbonate, intimately mixing the three after reducing to uniform powder, then transferring the whole to an oven and heating sufficient to start reaction, which results in a *stiff, pasty mass* which may then be *quickly passed through a No. 5 or 6 sieve* and will be dried by the time it cools.

These powders may be dispensed as effervescent powders, without granulating; they may be also compressed into effervescent tablets. Since they are prepared with the object of effervescing and furnishing a solution of the resulting salt in carbonic acid water, which is to be taken fresh, they should always be dispensed in perfectly closed containers, air and moisture excluded, and stored in cool places. When dispensed, directions to use water not *too* cold for dissolving will often save future explanations, and doubt of person using them.

B. G. E. Citrate of Lithium, 200 gm.
(5 gr. to teaspoonful.)

S. Teaspoonful in water 3 times a day.

200 gm. = $200 \times 15.432 = 3086.4$ gr.

Teaspoonful = about 90 grains G. E. salts.

$\therefore$ 200 gm. = about 34 doses.

34 $\times$ 5 gr. Lith. Cit. =	170 gr.
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Tartaric Acid $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 \times 2 =$	300 gr.
---	---------

Citric " $\text{H}_3\text{C}_6\text{H}_5\text{O}_7\text{H}_2\text{O} \times 3 =$	630 gr.
--	---------

Sod. Bicarb. $\text{NaHCO}_3 \times 5 =$	840 gr.
--	---------

Finely powdered sugar, qs. =	1146.4 gr.
------------------------------	------------

To make 34 doses @ 5 gr. each,	3086.4 gr.
--------------------------------	------------

Reduce each to fine powder, mix thoroughly, put into dish or stone jar previously warmed and put into an oven with heat about 100° to 120° C or 212° to 250° F. After a short time part of the water of crystallization of the citric acid will be liberated and a reaction will ensue resulting in a moist paste which should be removed from the oven, quickly stirred to coarse granules or passed through a sieve of five to eight meshes to the inch and allowed to cool in dry air; the powder is then ready to bottle and dispense.

d. Masses are soft solid or semi-solid preparations consisting of a medicinal substance and an excipient and are prepared or kept by the pharmacist to be used from which to prepare pills or lozenges, or they may be dispensed in bulk to be made into pills by the patient.

The nature of a mass varies according to its intended use: for preparing lozenges they consist largely of sugar and gum. A pill mass, however, should contain no more gum than is necessary, since a lozenge is desired to dissolve *slowly* in the mouth while a *pill* is to be swallowed, and should

rapidly disintegrate. Gum, particularly acacia, first forms around it a covering of dense mucilage and this protects the remainder from quick disintegration. Two masses are now official in the United States, namely, mass of mercury and mass of iron carbonate.

Other masses are to be prepared extemporaneously. The subject will be considered more thoroughly under the heading of *pills* (see page 126).

e. Lozenges are distinguished by shape and composition as:

- | | |
|---------------|---------------------|
| 1. Troches. | 4. Globules. |
| 2. Pastilles. | 5. Discs or Lamels. |
| 3. Bacils. | |

(1.) *Troches* are flat tablets of various shapes consisting of flavored and medicated sugar and gum cut from a sheet of dough previously rolled to proper thickness. They are intended to be dissolved slowly upon the tongue, thereby producing a slow and continued medication; hence they usually contain medicines of a mildly active nature either demulcent or expectorant. Sugar and gum, therefore, are excipients and aid in furnishing demulcent properties. A lozenge mass should be softer than a pill mass and yet not soft enough to warp in drying. The mass is rolled into a sheet upon a board or pill tile and cut into lozenges with a punch. The punch differs from a biscuit cutter only in being smaller and more elaborate. The lozenge sheet is rolled on a dough board, floured and cut in just the same manner as a biscuit dough.

(2.) *Pastilles* or drops are a kind of lozenge, usually shaped like a loaf and consisting largely of chocolate or glycerinated gelatine. They are usually prepared on a large scale by the manufacturing confectioner,

and are of little importance in practical pharmacy. A chocolate cream is a type.

(3.) *Bacils* are rod-like sticks prepared by rolling a mass into cylindrical strips and cutting; for instance, a pill pipe is placed upon the machine and, instead of being cut and rounded, the mass is pressed until it lengthens in the grove sufficient to fill a capsule; this, then, is a bacil: licorice bacils or pastilles are a common illustration. They, too, are a class of preparation of little importance to the pharmacist.

(4.) *Globules* of sugar, either spheres or hemispheres of cane sugar, are prescribed by homeopathic and other physicians to be saturated with liquid remedies and so dispensed. The globules, however, are made by confectioners and not by the pharmacist—of course, when charging them with medicinal substances, water must be avoided lest the globule be dissolved to syrup. They should always be dispensed in bottles.

(5.) *Discs* of glycerinated gelatine, containing mydriatic or myotic alkaloids, are prepared by dissolving the proper proportion in water, incorporating with gelatine solution and then dropping one or more drops of the gelatine solution upon a properly prepared surface, when, on cooling a minute, solid but thin discs remain.

These are used in ophthalmic practice, but are prepared by manufacturing pharmacists. Great care must be used in their preparation, to exclude dust, etc. They are sometimes called lamella and are administered under the eyelids.

℞. Trochisci PotassiiChloratis gr. v ana.

No. L.

S. Dissolve one upon the tongue as required.

Take of powdered chlorate of potash 250 gr., add

four times its weight of sugar, one-fifth its weight of gum tragacanth in fine powder and carefully stir together, then add water sufficient to form a plastic mass which is to be rolled into a thin sheet and cut into fifty lozenges by means of a die or lozenge punch.

The mass is treated like dough for biscuits and cut with a die similar only smaller.

f. Confections { 1. Conserves.
 2. Electuaries.

Confections may be:

(1) *Conserves* (or preserves) if composed of a fresh drug made into a paste pulp or mass with sugar sufficient to preserve (66% or less) and adhesive matter, if required, or

(2) *Electuaries*, if composed of *dried* drug made into mass with fruit pulp, sugar, honey, glycerine, etc.

At one time this class was considered very important, but now is not. Two confections are given in the National Formulary, but both are really electuaries and of the two confection of rose is worthless either as a remedy or an excipient, and is probably retained from custom. Confection of senna is a mild laxative. It may be stated that all confections consist of drugs, mild in action, made palatable by the use of sugar, flavor, etc. The French and Spanish Pharmacopœias still recognize a great many. One given in the French Codex has fifty-seven ingredients (apologies to Heinz).

Conserves are prepared by beating the fresh drug with sugar, adding sufficient gum, glycerine and flavor, if required, rubbing the mass through a sieve to remove solid particles. The mass is preserved and dispensed in glass pots or jars and is eaten

either as a candy or swallowed as a bolus, formed as desired by the patient.

Electuaries are prepared by taking the desired fruit (dried), steaming or boiling until soft, rubbing through a sieve and to this adding the dried drug, sugar, etc., and forming a mass which is preserved and dispensed in the same manner as a conserve.

A *linctus* is a similar preparation consisting of inorganic drugs mixed into a thick, pasty syrup, too thick to flow, and requiring the patient to lick it from a spoon. Such a preparation is made often from syrup, sulphur and cream of tartar.

g. Jellies	{	Gelatine Jellies	}	with which medicine
		Pectinous "		is combined and dis-
		Gum "		persed in bulk like an
		Starch "		ordinary confection,
		or Combinations		

or the jelly is made sufficiently strong to set or harden when cooled.

Jellies are used mainly to administer disagreeable fixed oils. Soft jellies are made into lozenges with which is incorporated a remedy desired to exert a prolonged and continuous local action on the mouth, tonsils, etc., hence are made to dissolve very slowly.

Oil jellies may be best prepared by using isinglass dissolved by heat in a flavored water to which sugar is added. The oil is made into an emulsion and the two combined thoroughly and allowed to gelatinize. This is a very satisfactory way to administer fixed oils, the jelly aiding in masking the taste; it should be dispensed in glass jar.

For preparing the jelly lozenges, a true gum or fruit pectin or other concentrated gum solution is mixed with syrup, flavor and medicine, evaporated to proper state, then poured into moulds to set, or

poured upon a pan or plate where it cools and sets in form of a sheet, which is then cut into desired size. These are really lozenge confections and are little used and seldom prepared by the pharmacist, although not difficult. None are official in the United States, but several formulas are given in the French and Spanish Pharmacopœias. The common old-style gum-drop is an example of the class so far as body is concerned. These jujubes, paste or jelly-gum lozenges may be dispensed in wax-paper-lined boxes or sprinkled with powdered sugar and dispensed in the ordinary glazed-paper-lined boxes.

h. **Pills** may be classified as:

1. Pills proper, when made to weigh from one to five grains.
2. Boli (singular bolus), made to weigh more than five grains.
3. Parvules, less than one grain, sugar coated, with coating colored pink or red.
4. Granules, sugar globules impregnated with a liquid medicine by absorption.

Concentric pills are made of successive layers of different medicines, each layer having a separate coating and composed of medicine of different therapeutic action, part to dissolve and be absorbed in the stomach, part in the intestines.

A pill is a small body of medicine of such size and shape that it may easily be swallowed and of such composition that it will rapidly disintegrate in the presence of the fluids of the stomach or intestines, that its effect may be promptly produced.

Pills are usually round or ovoid in shape and are usually of one to five grains' weight, but are sometimes smaller and quite frequently larger. If smaller than one grain and round a pill often is

called a *granule*, and if much larger is called a *bolus*.

A pill is made from a *mass* by rolling and dividing it and giving each pill the proper weight and shape, a simple and not difficult art, but success depends upon the *mass*, and the great variety of medicines given in pill form and their more varied physical and chemical properties render the making of perfect pill masses and pills the most difficult part of the pharmacist's practice. And, therefore, a good pill-maker may be considered a competent pharmacist.

Any medicine not volatile, sufficiently active that the dose be not too bulky, and not corrosive, may be given in pill form. Usually this form of dosage is selected with the object partly of avoiding the disagreeable taste of the medicine and also that the doses be definitely divided by the pharmacist.

Since pills should largely overcome the bad taste of the medicine, it follows that they are often *coated* for the same purpose, and also to preserve them from deterioration and to enhance their appearance, and occasionally to prevent their disintegration until they reach a particular part of the alimentary canal (enteric pills).

A *pill*, then, is formed from a mass and a *mass* is a stiff paste of medicine and an *excipient* or *massing agent*, which should *always* be *inert* medicinally. A mass must be soft enough to permit of being formed, cohesive enough to not crumble and firm enough to hold its shape when formed, and of such nature that when placed in water it will quickly disintegrate.

Since medicines given in pill form differ widely in their properties, so, also, must the properties of the excipient differ; the excipient, of course, must

furnish whatever properties the medicine lacks toward making a suitable mass. If the medicine be wet, then an absorbent excipient is used; if the medicine be dry, non-adhesive, then an adhesive excipient; if the medicine be dry and adhesive, then a solvent for the adhesive, etc., etc. Excipients, then, may be divided into two general classes: *Dry* and *Liquid*.

Dry excipients may be either Fibrous, Absorbent, Adhesive, or Absorbent and Adhesive.

If the medicine be quite wet and sticky, then a dry absorbent powder will, if carefully worked in, equalize the adhesiveness and form a mass; such substances often require a fibrous excipient to furnish framework to prevent flattening of the pill, especially if it gets too warm.

Fibrous excipients are absorbent—examples, elm bark, licorice, marshmallow root, etc.—but not all absorbent excipients are fibrous—examples, starch, flour, tragacanth, chalk, etc.

If the mass be quite moist but not sufficiently cohesive to hold without crumbling, then a *dry absorbent adhesive* powder is used. Tragacanth is par excellence for this purpose. Acacia or flour, etc., are used, but acacia is to be avoided because of its property of drying so hard and resisting solution so long. Russian licorice root powder and powdered slippery elm bark are very excellent *fibrous absorbent powders* and they also have some adhesive property; therefore, they have a wider range of usefulness than any other dry excipients.

If the medicine be dry and adhesive in nature a liquid suitable for developing that adhesiveness present is the best excipient—examples, water, alcohol, glycerine, glycerine and water—but if simply a dry powder with no adhesive property,

then a *moist adhesive* excipient is indicated. Many are used, each having its peculiar property and should be used where that property is most suitable. Mucilage and syrup of acacia, syrup, honey, glucose, glycerite of starch, glycerite of tragacanth or glycerine may be used as indicated. *As a rule, glycerine in small amount is always permissible* in a pill mass because of the fact that it will not permit the pill to dry too hard and will, therefore, ensure disintegration when taken. Of course these different classes may be combined as required. A liquid excipient should always be used sparingly since it must always be absorbed and the absorbent will increase the size of the pill.

The pill-maker should remember that the most important requirements of a finished pill are that it have the proper medicinal effect and, second, be as nice in appearance as possible so as to not make a disagreeable impression upon the mind of the patient. A large, ill-shapen pill may possess all the required medicinal properties, but often is revolting to the patient's tastes.

Drugs containing some resinous substances may be massed with soap and water or alcohol, the alkaline soap aiding in therapeutic action. Some substances which are administered with a purpose of acting on the lower bowel are combined with a hard resin so that solution will be slow and the pill reach the lower bowel before it disintegrates; such pills should be made with water or watery excipients—example, pill aloe and mastich. Volatile oils, creosote, phenols, etc., may be made into mass with wax, soap or, *better* with pure powdered extract of licorice and water; when wax is used it should be used as sparingly as possible and in fluid condition, adding sufficient fibrous excipient

to make a firm pill; too much wax would prevent disintegration of pill.

When substances with marked chemical activity are to be massed, then an excipient of a negative nature should be used. Pills of substances easily affected by the air should be coated immediately.

Oxidizing agents should not be associated with vegetable substances. For such articles as permanganate of potassium, silver nitrate, etc., an ointment made from equal parts kaolin, paraffin and petrolatum is an excellent excipient; other fatty excipients are cacao-butter, resin cerate, simple cerate, etc.

But the most difficult part of pill making is the actual manipulating—a student may learn how it should be done but only a pharmacist becomes proficient, because practice is necessary. A shallow, round-bottomed wedgwood mortar, with an extra long-handled pestle with a large crown that will fit the palm of the hand is best. Having mixed the ingredients properly the excipient is added with this purpose always in view, *viz.*, to get a pill not too large, that will have a proper appearance and will not fail to produce proper results from any act or omission of the pharmacist. Small, firm pills require a considerable kneading of the mass with the pestle rather than trituration. A good mass should cohere sufficiently so that it will be detached from both mortar and pestle by the act of kneading upon being completed, although some masses can not be made to do so. A short, stiff-bladed spatula is best for removing the mass from sides of the mortar. If a mass is properly made a dusting powder will be scarcely necessary, but when necessary should be used sparingly—white powder for white pills, etc. Starch is a good

white dusting powder: lycopodium, licorice powder, althea, etc., etc., are used. Pills are usually dispensed in pasteboard boxes, but may be enclosed in bottles; if so, powder should be added to absorb any moisture from the pills to prevent moulding. When the mass is made it is rolled into a cylinder or long "pipe" and cut on a graduated tile by means of a spatula, being careful that pills are uniform in size; or they are cut on a machine or pill cutter. They may be formed with the fingers and rounded with a finisher, or cut, formed, rounded and polished all by a few ingenious motions with the aid of the pill cutter.

To mask the taste of pills they are sometimes rolled into cylinders after being divided, and enclosed in gelatine capsules—the capsule also preserves the pill from the oxidizing effect of the air, etc. Be careful not to get any of the medicine on the outside of the capsule; always wash the hands after making the pills and before enclosing in capsules.

Pills are coated for the purposes of improving their appearance, preserving them, masking their taste and retarding solution so that the pill may pass the stomach and be dissolved in the intestines. Pill coating is an art which can be practiced to very little advantage by the pharmacist, as, coated, ready made pills can be had of nicer appearance and also at less cost than the pharmacist can produce them, unless a great number are made at one time.

According to general requirements and exigency the following several kinds of coatings are applied to pills, *viz.* .

Pill Coatings.

- | | |
|-------------|---------------|
| 1. Foil. | 5. Gelatine. |
| 2. Pearl. | 6. Collodion. |
| 3. Varnish. | 7. Salol. |
| 4. Sugar. | 8. Keratin. |

(1.) *Foil coating* is the oldest and simplest method and least used. Formerly it was common, but now is rare. The pills should be made *slightly* softer than usual and a conspergative not used, so that finished pill may be slightly adhesive when placed in a coater or round box with "leaf" of silver, gold or aluminum and shaken until coated, then rolled smooth with a pill rounder until polished and free from adhering loose particles.

(2.) *Pearl coating* is so named because of the slight pearly appearance, but consists of an insoluble powder coating made to adhere by use of syrup or mucilage or both. The pills are dropped into a mortar containing syrup of acacia or other suitable adhesive, rotated until completely covered with the adhesive liquid, then rolled into a mixture of talc, starch, sugar of milk, chalk or some such combination and allowed to dry, when the surplus powder is removed by rounding as with foil coating.

A good pearl coating powder	{	Acacia.....1.
consists of	{	Sacch. Lact...5.
	{	Amyli.....1.
	{	Talci.....1.

(3.) *Varnish coating* consists of a resin applied in solution in a volatile liquid, by spraying the solution onto the pills from an atomizer or, better, by rolling the pills in a mortar containing the resin solution or varnish, then placing on wax paper until the volatile solvent has evaporated. Ether solution of tolu, mastic, sandaric or mixtures of these, is used for this purpose.

(4.) *Sugar coating* is done by machinery on a large scale and is entirely impractical for the retail pharmacist. So is gelatine coating, nowadays, because pills coated by machinery can be had better and cheaper than the pharmacist can possibly coat them on a small scale, yet neither process is impossible. In *sugar coating* the pills are put into a globular drum revolving upon an axis in an oblique position, thick syrup is poured upon the pills and as the drum revolves, becomes distributed to all parts of the surface of every pill. Warm, dry air evaporates the water and the constant rolling of the pills over each other wears the surfaces smooth by attrition.

(5.) *Gelatine coating* is applied by dipping the pills into a solution of gelatine gum and glycerine or gelatine albumen and glycerine, or a similar combination, often containing sugar, allowing the adherent gelatine to dry during a rotary moving of the pill to prevent the solution running off or running too much to one side of the pill.

(6.) *Collodion coating* is applied like varnish coating to a pill which must be perfectly dry on the outside, otherwise the moisture precipitates the collodion.

(7.) *Salol coating* is also applied in the same manner after being previously fused at the lowest possible temperature, preferably with a little resin, or else it may be dissolved twenty per cent. in ether. Salol coating may not be used upon a pill the excipient of which was glycerine. Salol and collodion are seldom used but are very valuable as extemporaneous enteric coatings.

(8.) *Keratin coating* is used for enteric pills—pills that will pass the stomach undissolved, but will disintegrate in the intestines (plus bile and

pancreatin, etc.). Keratin is a complex gelatinoid substance found in horns, hoofs, feathers, hair, etc., and is very difficultly soluble, being insoluble in water, alcohol, ether, dilute acids, dilute alkalies, and digestive ferments of the stomach. To prepare it, horn substance, in shavings, is first deprived of fats by digestion with ether; albuminoids are then removed by digestion in dilute hydrochloric acid and pepsin; wash and dissolve the residue in five per cent. ammonia, filter and evaporate to dryness; this is then dissolved in either alcoholic ammonia or glacial acetic acid, accordingly as the substance be used with acid or alkali. The solution is applied to pills made with a fatty base and no water, by the same process as for varnish coating.

2. SOLID PREPARATIONS FOR EXTERNAL APPLICATION:

Ointments are solids or semi-solids, usually of a fatty nature, soft enough so that they may be spread upon the surface of the body and melted with body heat. Ointments are always applied externally, but are often used by the physician as a means of systemic medication since, by osmosis some medicines combined with a favorable base will pass through body tissues into the circulation and affect the system. Certain parts of the body will more readily permit of this mode of medication, namely, the armpits and groins. Also certain fatty substances *favor* the absorption of the medicine; other fatty substances *permit* this to a *less degree*, while still others are *non-absorbable*.

Ointments may be prepared by:

- (1.) Simple mixture of base and agent.
- (2.) Fusion of base and mixing with agent.

(3.) Chemical reaction.

and are used for:

- (1.) Protection of wounds and raw surfaces, and softening the skin and tissues.
- (2.) Producing a mildly irritant or stimulating effect upon the skin, or as an antiseptic or disinfectant of ulcers.
- (3.) To carry anodyne or other systemic drugs and aid in their absorption into the circulation.

They, therefore, vary in composition of base as well as active medicine; bland *protective* or *emollient* ointments, not to have marked physiological effect, are prepared with petrolatum or a similar fatty hydrocarbon.

Stimulating, irritating or rubefacient ointments which carry a remedy to act upon the skin should be prepared with a vegetable oil or mixture of vegetable oils, and wax or animal fat, or wax and lard; while ointments which are intended to affect the system, i. e., absorbed into the circulation, are prepared from wool-fat or lard.

Wool-fat is a very valuable ointment base since it will be absorbed more readily than any other fat and also because it will hold in permanent admixture a very large amount of liquid, of either water, glycerine, alcohol or fatty nature.

The common form in which wool-fat is used, 'lanolin,' is a preparation containing about sixty-five parts anhydrous wool-fat to thirty-five parts of water.

All animal and vegetable oils, fats and waxes tend to oxidize or rancidify, especially under the influence of air, water and heat. A fat kept free from water and air will keep indefinitely, but if air be allowed free access decomposition will soon begin; oxy-oleic acid usually forms, which is of a dis-

agreeable odor and is irritating to a delicate surface or tissue, therefore ointments should always be fresh. Various substances are used to prevent this deterioration, such as solution of resins, etc., in the fats, but they avail very little as compared with the exclusion of water and air and protection from too much heat.

The only benzoinated lard which will keep is the dehydrated, and it will keep as long as it remains free from water, but not very much longer. But ointments are often used to apply medicines which must be dissolved in water, also ointments are sometimes prepared with water which, evaporating, cools and soothes feverish surfaces.

Wool-fat will hold a very large amount of water; lard, also, will take up about fifteen percent. water, and other fats less; petrolatum very little. Wax, however, fused with the fat, will greatly increase the power of fat to hold water and at the same time tend to act as a preservative agent.

When water is to be added to an ointment base of fat and wax the mixture should be fused but not heated too highly, the water should be at the same temperature, and all added at once and rapidly stirred until completely mixed, and no longer. *Petrolatum*, vaseline, etc., *do not become rancid*.

A medicinal substance should be either dissolved in the base, reduced to *finest* powder or dissolved in water before being incorporated into an ointment. No gritty particles or lumps should ever be present in an ointment.

Vegetable extracts should be made into a thin paste with water or water and alcohol or glycerine.

Very often substances are prescribed together in an ointment which are incompatible and tend to form granular or gritty particles; this may some-

times be prevented by making an ointment with each separate refractory substance and part of the base and afterward combining the whole into a smooth ointment.

Care should always be taken that every portion of the ointment contains the same proportion of medicine: this can be insured by following the same method used with triturations, viz., take the medicinal substance and with it mix an equal amount of the base, thoroughly incorporate, then add more of base, etc., until all is mixed. Some pharmacists when preparing ointments of such active agents as salts of mercury, etc., mix the finely powdered substance with some bland oil first; then, after thorough mixture, add the ointment base in portions. This process is excellent, but a small portion of the base, instead of the bland oil first taken, answers just as well and does not tend to lower the melting point of the ointment. Ointments should be firm enough to "stand up" or remain solid at any temperature below 90° F., otherwise they melt and when melted the solids would separate.

Fats consist principally of two portions at normal temperature—a solid portion (stearin) and a liquid portion (olein) in varied proportions; if the olein predominates, they melt too readily and wax is usually added to raise the melting point.

When wax or resin is added or when a liquid and solid fat are to be mixed, the substance having the highest melting point should be fused first and at *no higher temperature than necessary* and the others mixed in order of their melting point, the fused mass stirred sufficiently to prevent separation of the different portions while the mixture be cooled as rapidly as practicable. If violent agitation be used and continued until the ointment becomes solid, consider-

able air is incorporated—this tends to render the ointment lighter in color but more prone to become rancid.

Ointments should be kept in a cool, *clean, dry* place remote from odors, and dispensed in glass.

In preparing ointments, utensils should be used which will not react with the medicinal portions. Most ointments can be mixed on a tile with a steel spatula—especially if no water be present to enable reaction, but salts of mercury or silver, tannin, etc., should be stirred with glass, or a horn or rubber spatula used if there be water present. Phenols and some phenol derivatives, chloral and stearoptenes tend to liquefy fats. In such ointments sufficient wax may be used to raise the fusing point, or powdered starch may be used to stiffen the ointment without raising the melting point.

Ointments of solid fats and powders are best mixed on a tile of glass, glazed porcelain or marble, while thin ointments and those made by incorporation of a liquid may be made in a warm mortar. In addition to fatty substances other substances are sometimes used as ointment bases.

Glycerite of starch, or a mixture of tragacanth, mucilage and glycerine, or glycerine solution of gelatine and oils, or soft soap, or super-fatted soaps, or mixtures of casein, soap and fats, each has its respective domain as a vehicle for ointments.

Mulls—Mullæ N. F.—May be called soft plasters, being ointments having a rather high melting point, and are used after being spread on cloth.

Benzoinated Suet.—Sevum Benzoinatum—or a

mixture of lard and wax having approximately the same melting point ($45-50^{\circ}\text{C}$) is the usual vehicle.

After being spread on cloth and cooled, the mull should be covered with oiled paper, rolled loosely and dispensed in a pasteboard cylinder or box.

About 30 Gm. (1 ounce) of mull is sufficient to cover five square inches when spread.

Inunction—Inunctum N. F.—This is a soft ointment intended to influence the deeper tissues and usually contains hydrous wool fat as the vehicle.

Petroxolin—Petroxolinum.—A useful vehicle for external applications is the mixture of oleic acid, ammonia, alcohol, petrolatum, etc., listed in the National Formulary under the title *Petroxolinum Spissum*.

If a liquid application is wanted *Petroxolinum Liquidum* may be used. Any medicament suitable for external application and not incompatible with ammonium oleate or oleic acid may be added to this vehicle, but it is generally used to carry drugs such as iodine, creosote, guaiacol, methyl salicylate, etc., into the deeper tissues or to secure systematic effects from the local application of these drugs.

Pastes—Pastae N. F.—Are similar to ointments, but as a rule contain a smaller proportion of fatty vehicle. Thorough trituration is required to make a smooth mixture of most of the official pastes and, since the solid medicaments and inert powders together usually are from one-third to one-half of the total, the paste is stiffer and gives a denser covering when applied than the ordinary ointment does.

Zinc oxide, resorcinol, sulphur, salicylic acid, calcium carbonate, balsam peru, bismuth subnitrate, etc., may with advantage be prescribed as pastes and talc or starch may be added to make the mixture dense if the proportion of active ingredient is not over one-third. Petrolatum is the usual fatty vehicle since a local action only is wanted.

Glycero-gelatins.—In some conditions where a firm, almost rigid, medicated dressing is to be applied externally and not disturbed except at rather long intervals, as for example, in varicosis of the veins of the leg, mixtures of medicaments with the glycerinated gelatin of the pharmacopœia are very serviceable.

The medicament, usually zinc oxide, salicylic acid, idoform or similar drug, should be thoroughly mixed with the melted glycerinated gelatin and the mixture poured into a shallow pan; when cold the mass should be cut into small pieces, each of sufficient size for one application and each piece wrapped in oiled paper.

Ordinarily, a piece $\frac{1}{2} \times \frac{1}{2} \times 1\frac{1}{2}$ inches will cover an area of about six or eight square inches.

The patient should be instructed to melt the piece and apply it with a brush.

Cerates are really ointments, only they contain sufficient wax not to melt at body heat, therefore are used as protective dressings more than to exhibit medicines to be absorbed. Wax tends to prevent absorption. Medicinal substances should never be heated with *unmelted* fats, particularly vegetable substances: too high heat is apt to cause

decomposition, lumping, etc., and at a high heat the water usually present in the medicinal vegetable substances may decompose some of the fat forming irritating compounds and causing the ointment, further, to rapidly become rancid.

Suppositories are solid bodies of ointment material made of such shape as will favor their being introduced into the body cavities or openings, and of such consistence that they will *always* melt at the body temperature. Their effect, when applied, is like any other ointment and their preparation is like that of other ointments plus the precaution that they must be solid at ordinary temperature but *always* melt at $98.6^{\circ} F.$; therefore, the choice of base material must be limited to such as have these requirements, either natural product or a mixture.

Suppositories are made of different sizes and shapes according to intended use.

Rectal,	cone shaped	.....	30 grains
Vaginal,	"	"	60 "
Urethral,	pencil	"	15 "
Aural,	round	"	5 "
Nasal,	wedge	"	10 "

The first three are the most common.

Cacao-butter is the best suppository base; mixtures of oil and wax or lanolin and wax or oleic and stearic acid may be used in proper proportions.

When chloral or other article that softens the vehicle is ordered, spermaceti in proportions up to 15% of the total may be added. Gelatine and glycerine, sodium stearate (stearin soap) or sodium stearate and glycerite of starch may also be used. All may be made by casting in chilled moulds from a fused mass, or if sufficiently firm they may be formed by hand or compressed in dies by machine.

If a liquid like glycerine is to be made into suppositories a solution of sodium stearate in the liquid, effected by aid of heat, will, upon cooling, hold the liquid and yet be solid enough to introduce, or molecular proportions of sodium carbonate and stearic acid united will give the same result or better. But soap is not to be used with salts of the metals, tannin, etc., nor should gelatine be so used.

Most suppositories are made from cacao-butter, and when no excipient is specified it should be used.

As with an ointment, the medicinal substance should be in finest powder, contain no grit or lumps, the cacao-butter grated and the medicinal agent and part of the cacao-butter mixed perfectly, the remainder of the cacao-butter incorporated, the whole worked into a *plastic mass*, rolled into a cylindrical shape, cut into the desired number of parts and formed by hand, or the plastic mass put into a suitable machine and compressed in required manner, or the medicinal agent is mixed properly with a suitable first portion of cacao-butter and the remainder of the cacao-butter fused by means of a water bath and added, the whole stirred until intimately mixed and poured into moulds previously chilled. If the suppository should stick in the mould, lubricate mould with tincture green soap. Under no circumstances should the medicinal matter be heated with the base. Care must be exercised that the melted mass be almost ready to congeal before being poured into the moulds, which must be cold so that the mass will solidify before the medicinal portion can settle to the point of the suppository.

When forming suppositories by hand the fingers should be kept well powdered with powdered starch to prevent the heat from them softening the suppository, and when formed the suppository may

best be sprinkled with powdered starch. *Lycopodium* is slightly irritating to mucous membranes and should not be used; starch is cleaner and better. Suppositories should be dispensed in boxes lined with paraffined paper and bearing a label to "keep in a cool place."

Glycerinated gelatine is used as an excipient or base for preparing many suppositories. It can be used, however, only by using the moulding process. One part by weight of gelatine is first covered with cold water and upon standing twenty to thirty minutes the gelatine is softened and absorbs considerable water. It will now dissolve if heated with one part glycerine, but the water must be carefully evaporated, when the solution is poured into a lubricated mould and allowed to cool and should be allowed to stand some time in a cool place until sufficiently firm.

Plasters are solid masses similar to ointments, but are spread upon paper, skin or textiles to be applied to the skin and are of such consistency that they must be heated to be spread and usually require heat to make them adhere to the skin. They are composed of metallic oleates or the same mixed with resins, waxes, soap, etc., or rubber and the medicinal substance; or, like court-plaster, they consist of a textile upon the face of which is spread a solution of gelatine and the back sized with tincture of benzoin. The gelatine solution is sometimes medicated with a mild remedial agent, antiseptic or such. So-called mull plasters consist of an inert base spread upon mull cloth and this used as a body or base upon which medicinal matter or another plaster mass is spread.

Ordinary plaster base or "adhesive plaster" is

lead oleate made more adhesive with rubber, two percent., and two percent. petrolatum added to favor handling.

Common lead plaster or lead oleate is prepared by precipitation from solutions of lead acetate and sodium oleate or Castile soap. If from soap then there is some lead stearate present, but may be overlooked. The lead oleate is rolled until water is worked out and then wrapped in wax paper to exclude air; even then it spoils on the outside, getting brown and brittle—that portion should be removed. Lead plaster, when spread, rapidly becomes non-adhesive, hard and worthless.

With very few exceptions plasters fail to exert any medicinal activity, but afford support and protection and continue in use from former customs. While made now almost entirely by machinery, in large numbers, their preparation by the pharmacist at the prescription counter offers no difficulty. Three utensils are necessary—first, a *good*, stiff, *smooth* spatula; then a water bath and a block or board of soft pine upon which to pin the paper, skin or cloth used to spread the plaster on; the plaster mass is *just* melted, the *polished* spatula dipped in hot water and used to spread the fused mass into a form cut from metal or cardboard and laid upon the cloth. The plaster, when cool, should be covered with paraffined paper and dispensed in a box or rolled loosely.

Oleates are definite chemical salts of oleic acid and an alkaloid, or an alkaline hydroxide or a metallic oxide, usually with oleic acid in slight excess. They may be prepared by direct union of the two substances chosen, the reaction being favored by moderate heat and a little alcohol or

water to start it. Or soluble oleates may be mixed in solution with the solution of a salt of the metal, using molecular proportions. The soluble oleates are those of the alkalies. The metallic oleates are the true plasters. The alkaloid oleates are soluble in excess of oleic acid and in oils, and most oleates are applied in the form of an ointment, being miscible with the various fatty substances. The preparation or compounding and the preserving and dispensing of oleates and ointments of the oleates are, of course, subject to the same considerations as are ointments.

Poultices are solid or semi-solid mushes, or moist bundles of fabrics, hot or cold, plain or medicated, used to produce anodyne, stimulant or vesicant effects by applying to the surface of the body.

A poultice may be either a

Cataplasm,

Fomentation, or

Compress.

1. A *cataplasm* is a mushy, plastic, wet mass of farinaceous matter with or without medication, but hot as can be borne by the surface, and made of material to retain heat as long as possible and to be reheated when beginning to cool—examples, flax, bread, bran and clay cataplasms.

An exception to the above is the cataplasm or poultice of mustard, which should never be prepared with hot water, but with only tepid water, since the water combining with a ferment in the mustard generates the volatile oil to which the action of the mustard is due, and would, if hot, volatilize the oil and otherwise heat would spoil the preparation.

2. A *fomentation* is a woolen or other cloth which does not readily cool, saturated with a *hot* infusion of herbs and applied hot as can be borne.

3. A *compress* is a dry, hot, or ice-cold body to carry heat or cold to the part to which applied, or it may be a wet, fibrous substance charged with hot or cold water or medicated solution.

Medicated gauzes and cottons are prepared mostly by specialty manufacturers, but are sometimes wanted of composition not obtainable ready made; they consist usually of sterilized cotton or gauze containing a certain percent. of an antiseptic or disinfectant agent and are used for keeping fresh wounds, etc., aseptic, and also to disinfect old sores, ulcers, etc., they may also contain glycerine or oil and resin to keep them soft. To prepare them the medicine is dissolved in ether or a suitable volatile solvent; to this solution is added glycerine or oil and resin; the solution is then absorbed by the cotton or gauze and thoroughly diffused through it, wrung out and the preparation quickly dried without heat, in the dry air. They should be prepared with the utmost cleanliness and kept in tight containers.

The proportion or percentage of medicinal matter must be related to the finished product, not to the first weight of the gauze or cotton.

Vehicles and Diluents.—Each physician going into practice soon selects a few vehicles, diluents or solvents, learns the scope of their usefulness and then orders them mixed with the active medicament in prescriptions to make sufficient volume or bulk so that the dosage may be conveniently dispensed, measured and administered. One of the important opportunities open to a pharmacist for service to physicians whose prescriptions come frequently to his store is in connection with the selection of these diluents and solvents.

If the active drug is to be dispensed as a solid—that is, as a powder or in capsules, pills, charts, cachets, etc.—milk sugar is probably the most generally useful diluent, especially for powders or charts, capsules and cachets.

If the dose of the drug ordered is less than one grain (.06 Gm.) it is good practice to add to each dose about 3 grs. (.2 Gm.) of milk sugar, thereby increasing the bulk of the powder so that it is easily divided into portions and easily manipulated by the dispenser and also so that the patient can easily handle a single dose.

Aromatic Powder (*Pulvis Aromaticus*) and Powdered Sugar (*Sacchari Pulvis*) are also generally useful as diluents for dry medicaments given internally.

Starch (*Amylum*) or Talc (*Talcum Purificatum*) are used as diluents for dry powders used externally.

If the prescription be made into pills, Solid Extract of Gentian (*Extractum Genitanae*) is very serviceable as a diluent and adhesive and should be added in sufficient quantity to bring the total weight of each pill to about 3 grs. (.2 Gm.).

When it becomes necessary to add a diluent or solvent to a liquid preparation it is desirable to know whether the drugs ordered contain much or little alcohol, or none at all, whether solids are to be dissolved, whether, in addition to adding a diluent to increase the bulk or volume of the liquid, it is also desirable to add color and flavor.

Probably the most generally useful diluent for liquids is Red Aromatic Elixir (Elixir Aromaticum Rubrum) (see Elixirs), which is miscible not only with very many aqueous liquids, but also with many liquids of low alcoholic strength and, moreover, is both flavored and colored.

When this elixir is mixed with liquids containing a high percentage of alcohol, precipitation, if any occurs, is usually of such a nature that the mixture when shaken becomes uniform throughout its bulk and while "shake mixtures" are undesirable they may be used at times, if the separated solids mix easily with the remainder when shaken.

Most of the salts or solids which can be dissolved in water will also dissolve in Simple Elixir in sufficient proportion for medical use.

If the alcohol contained in Simple Elixir is objectionable and water alone is suitable, it is good practice to order one of the aromatic waters—peppermint water and chloroform water being two popular ones.

Simple Syrup (Syrupus), Syrup Tolu (Syrupus Tolutanus), Syrup Yerba Santa Aromatic (Syrupus Eriodictyi Aromaticus), Syrup Orange Flower (Syrupus Aurantii Florum) are also of use when a sweet diluent is desired.

Concentrated solutions of such salts as Potassium Iodide, Ammonium Chloride, Sodium Bromide are

usually more acceptable if free from aromatics or added flavors. The dose, when taken, should be diluted considerably with water, and then followed with a drink of water, milk, tea, coffee, etc.

If a high percentage of alcohol is desirable, and the exact percentage wanted is known, that percentage should be ordered, or at all events should be approximated.

Formerly Whiskey (*Spiritus Frumenti*) or Brandy (*Spiritus Vini Gallici*) were occasionally used as diluents in such cases.

In addition to the foregoing the following elixirs are of service as diluents, solvents or vehicles in liquids for internal use:

Aromatic Elixir (*Elixir Aromaticum*).

Elixir Bitter Orange (*Elixir Aurantii Amari*).

Elixir Anise (*Elixir Anisi*).

Elixir Almond Compound (*Elixir Amygdalæ Compositum*).

Elixir Cardamon Compound (*Elixir Cardamoni Compositum*).

Elixir Eriodicyton Aromatic (*Elixir Eriodictyi Aromaticum*).

Elixir Glycyrrhiza Aromatic (*Elixir Glycyrrhizæ Aromaticum*).

Elixir Taraxacum Compound (*Elixir Taraxaci Compositum*).

Elixir Vanillin Compound (*Elixir Vanillini Compositum*).

Elixir Pepsin (*Elixir Pepsini*).

Elixir Pepsin Lactated and Elixir Pepsin Compound (*Elixir Pepsini Compositum*) are largely used since they serve as diluents and also in some circumstances as correctives.

As usually prepared, the last two elixirs are a

dark red color. The first five elixirs in the above list are nearly or quite colorless; the next five much darker amber or red.

For ointments, Petrolatum (Petrolatum) is the most generally used diluent; if a more absorbable diluent is wanted, Lard Benzoinated (Adeps Benzoinatus) may be used or a part of the diluent may be Hydrous Wool Fat (Adeps Lanæ Hydrosus). Solid Petroxolin (Petroxolinum Spissum) is also very useful as a vehicle for external applications.

For oily liquids used externally or as nasal sprays, Liquid Petrolatum (Petrolatum Liquidum) is generally ordered as the diluent.

Soap Liniment (Linimentum Saponis) is a useful diluent in alcoholic liniments.

Very few official elixirs, syrups, ointments, etc., require the addition of diluents if administered to adults: for children, the bulk of the dose may be reduced or if, as many prefer to do, the dose of liquid mixtures be made one teaspoonful, then a diluent is required.

Generally speaking, the physician who makes his prescription fit the case, has frequent need to order diluents, vehicles or solvents and should have some acquaintance with an extensive list of such preparations.

Any of the diluents named in the foregoing may be prescribed at times in some cases as a placebo—an article given to please the patient rather than for therapeutic effects.

Liquids for internal use :

Solutions, Liquors, Succus, Juice.

Waters.

Infusions, Infused Oils.

Decoctions.

Syrups.

Honeys.

Elixirs.

Spirits.

Vehicles, Diluents.

Mucilages.

Emulsions, Milks, Magma.

Mixtures.

Liquids for external use :

Collodions.

Liniments.

Petroxolins, Liquid.

Enemas.

Gargles. .

Baths.

Lotions.

Sprays, Nebula.

Inhalations.

From the above classification there have been omitted a few classes—fluidextracts, fluidglycerates, tinctures, wines, oleoresins, etc.—that cannot be well made extemporaneously.

LIQUIDS FOR INTERNAL USE.

- a.* **Solutions** { 1. Simple.
 { 2. Compound solutions.

A simple or physical solution is a transparent liquid resulting from the homogeneous blending of the molecules of two substances in such a manner that neither alters its chemical identity.

The substance dissolved may be either solid, liquid or gaseous; the dissolving substance is usually a liquid and called the solvent; however, solids may liquefy or pass into solution when brought together and one liquid may be dissolved in another. Heat, as a rule, favors solution of solids and liquids, but of course retards solution of gaseous substances. Nor is it *always* true of solids, some solids being less soluble in warm than in cold liquids. When the solvent is not specified water is always to be used.

Solids and liquids are more easily dissolved if in a fine state of division and solution is aided by agitation, stirring, etc., since it brings fresh portions of the solvent in contact with the substance successively.

Some solids dropped into a solvent will begin to dissolve and form a dense solution around the particles, which protect the remaining undissolved portion from the remaining liquid, hence the necessity of agitation; particularly is this true of gums and most colloidal bodies, which are best dissolved by stirring coarse pieces with water.

Scale salts of iron, scale pepsin, gums, etc., may be dissolved more readily if added to the solvent and stirred than if placed in the vessel and the liquid poured upon them.

Drugs containing saponin, soap, extract licorice or other substances which froth should not be shaken with a liquid in a partly filled bottle if that bottle is to be filled subsequently; when such a condition results the froth will sometimes break if treated with a few drops of alcohol or potassium hydroxide solution. Such mixtures would better be made in a mortar. As a rule solids should not be placed in the prescription bottle and the bottle filled with solvent. If practicable, solution prescriptions should be filtered.

Solutions should be prepared with the solvent at normal temperature without the use of heat, if practicable. Many substances are injured by heating and this should be carefully considered, especially with reference to organic substances.

Solutions are *saturated* when no more of the substance will be dissolved by the solvent, and a saturated solution, therefore, is of definite strength, only when prepared at a definite temperature, now prescribed at 25° C. by the Pharmacopœia.

A **supersaturated solution** is one containing in solution more substance than the solvent would dissolve at that temperature. Many salts will dissolve to a far greater extent in warm water than in cool; if water is saturated at a high temperature with a salt, the resultant solution in some cases may be cooled to a lower temperature without the separation of the solid: usually in such a solution crystals will form rapidly upon slight disturbance, especially if a crystal of the dissolved substance

be suspended or dropped in that solution. A mixture of solution and an excess of the substance which is in solution with it, does not constitute a supersaturated solution.

Phenol crystals, heated, will liquefy with ten or five percent. of water added—this is a solution of water in phenol: if it be at perfect rest and allowed to cool slowly, it sometimes happens that upon the slightest touch the solution immediately solidifies to a mass of needle-shaped crystals.

A percentage solution contains a certain number of *parts by weight* of the substance in solvent enough to make *100 parts by weight* of solution. So-called percentage solutions are sometimes prepared by taking weight parts of solid and volume parts of liquid; such solutions, while not percentage solutions, are of value in pharmacy since liquid medicines are administered by volume measures, but true percentage solutions cannot be made that way.

A number of solutions are official in the U. S. P. under the title *liquores*. In dispensing prescriptions for solids and liquids together, if possible the solid should be dissolved. A solution is always improved in appearance, transparency, etc., by being filtered; often, too, filtration will aid in preserving a liquid. To prepare a solution of a solid the solid should be placed in a deep mortar, pulverized if necessary, a portion of the liquid poured on and stirred or triturated until no more solid will dissolve, the solution poured off and the operation repeated with fresh portions of solvent until complete solution is effected.

For the purpose here deemed most practical we will consider a *compound solution* as a solution of a substance in a liquid solvent prepared by means of a third substance as a necessary auxiliary.

Some substances are soluble in water or ordinary solvents to a limited extent, or they may be almost insoluble therein and yet are perfectly soluble in a solution of another substance, without the interchange of molecules, or without chemical reaction. These substances when used as solvents may be called auxiliary solvents or compound solvents. Below we give a list of substances which are soluble to only a limited extent in water, with corresponding auxiliary solvents, by the use of which a more or less concentrated solution may be easily effected.

Compound Solvents:

SUBSTANCE.	AUXILIARY SOLVENT.
Acid Benzoic	Sodium Benzoate, Phosphate, Sulphate.
Acid Boric.....	Sodium Borate, Glycerine, Sugar.
Acid Gallic	Potassium Citrate.
Acid Salicylic.....	Borax.
Bismuth Citrate.....	Ammonia water.
Bismuth Subcarbonate..	Ammonium Carbonate.
Borates.....	Boric Acid. Bitartrates.
Borax.....	Sugar.
Bromine	Potassium Bromide, Sod. Bromide, Am. Brom.
Calcium Hydroxide.....	Sugar.
Calcium Phosphate	Ammonium Chloride. "
Chrysarobin.....	Alkalies.
Citrates.....	Sodium, Potassium, or Ammonium Citrate.
Cotton.....	Ammonio-Sulphate of Copper.
Iodine	Potassium Iodide.
Iron Carbonate.....	Sugar.
Iron Oxalate.....	Oxalic Acid
Iron Oxide and Hydroxide.....	Sugar.
Iron Phosphate, Pyrophosphate and Tartrate.....	Alkali Citrates and Tartrates.
Mercury Bichloride....	Ammonium Chloride, Sodium Chloride, Hydrochloric Acid.
Mercury Biniodide.....	Potassium Iodide, Sodium Thiosulphate.
Mercury Sulphate.....	Potassium Sulphate.
Mercur Ammonium Chloride	Ammonium Acetate, Carbonate, or Nitrate.
Pepsin	Hydrochloric Acid.
Phosphates	Alkali Phosphates, Am. Acetate.
Potassium Bitartrate...	Borax and Alkalies.
Pyrophosphates.....	Alkali Pyrophosphates, Citrates.
Silver Cyanide.....	Potassium Cyanide, Sodium Thiosulphate, Ammonia.
Silver Iodide.....	Potassium Cyanide, Alkali Iodides.
Tartrates	Tartaric Acid, Caustic Alkalies.
Zinc Carbonate.....	Ammonia water.
Zinc Oxide	Ammonium Carbonate.

We should carefully consider the difference between the meaning of the term *solution*, a pharmacopœial preparation, and *solution* as used to define a state of aggregation of matter. As to the correct definition of the latter term there is much difference of opinion and therefore it is undefined.

In the case of bases, acids and salts which may be decomposed by the electric current by passing it through their solutions, the positive radicle gathers at the negative electrode while the negative radicle gathers at the positive electrode, and it is further claimed that electrolytes (bodies capable of decomposition by electrolysis) when in solution are in a state of dissociation into their respective radicles or elemental particles; these particles being called ions and that when any salt, acid or base is dissolved in water it is dissociated into its respective ions, more or less, according to the state of dilution of the solution; complete dissociation being possible only in an infinitely dilute solution. And also that the color of a solution is the color of the ions in that solution and that the chemical properties are the properties of the ions—example, water solution of copper sulphate contains Cu ions and also SO_4 ions separated. Upon passing the electric current through the solution the copper ions are deposited in a dissociated pure metallic state upon the negative electrode while the acid remains in the solution in contact with the positive electrode.

A chemical solution is usually considered as a solution of a body in a liquid whereby a chemical change takes place producing a new compound distinct and different from the original—example, chalk dissolved in dilute acetic acid. But the above definition and example do not clearly and accurately define the term chemical solution. First there was

a chemical reaction and immediately afterward the new compound formed by that reaction was dissolved by simple solution. If, however, carbon dioxide be dissolved in water carbonic acid is formed. When any anhydride dissolves in water the corresponding acid is formed.

Crystalline solids, with water of crystallization, and some others when dissolved in water rapidly, lower the temperature by using the heat to effect solution. On the other hand, anhydrous salts capable of crystallizing with crystal water dissolve with evolution of heat and a considerable reduction of volume. Some liquids produce the same phenomenon—the greater the amount of heat evolved the greater the reduction in volume. It is undoubtedly because of a physical union of the molecules of the substance with the water, while in the case of crystals containing water or those which *will not unite chemically* with it, the heat is nearly used up to effect solution. On the other hand, the formation of crystals gives off heat which usually is not manifested because evaporation of some liquid again utilizes it. Chloride of ammonium and nitrate of potassium dissolved in water lower temperature greatly. Ten parts of potassium iodide with six parts of water, by weight, dissolved rapidly, under certain conditions may cause a deposit of water on the outside of the flask which, upon further shaking of flask, freezes to ice, while beside it at same time ten parts sodium hydroxide plus six parts water under certain conditions may evolve so much heat as to render handling of flask impossible.

Some deliquescent salts when moist will absorb heat while being dissolved, but if they be rendered *anhydrous* will dissolve with evolution of heat; so

also will some salts which are capable of crystallizing with water of crystallization, but which have been rendered anhydrous, first evolve heat while they combine chemically with water of crystallization, after which the newly formed substance dissolves with absorption of heat, first raising then lowering the temperature—example, fused calcium chloride.

Solutions of some substances will, when that substance begins to crystallize, evolve heat. The thermolite bag furnishes an exaggerated but very useful example of the evolution of heat from the formation of crystals.

There are no solvents capable of dissolving all substances. There are no solid substances soluble in all liquids. There are no substances absolutely insoluble in cold solvents and yet soluble in the same solvents when heated. Solubility of substances varies very greatly: 1 part water dissolves 3 parts zinc chloride or tannin, but 800,000 parts are necessary to dissolve 1 part barium sulphate, and 2,000,000 parts water for 1 part silver bromide.

“Solubility” of substances, usually, is considered at 25° C. in water, and the knowledge of the relative solubility of many substances is a great aid to the pharmacist (see table following.)

Relative Solubility of Substances in Water.

Compounds.	Those Soluble.	Those relatively not Soluble.	Special Remarks.
Acetates	All, except	Quinine acetate..	All are soluble in HCl and NH_4Cl .
Arsenites } Arsenates }	Those of alkalis	All others	
Benzoates	Nearly all.....	Benzoic acid.....	
Borates.....	Of alkali-metals	Metallic	{ Benzoic acid soluble in alcohol. Aq. sol. sod. benzoate, phosphate, sul- phate. Sol. in dilute inorganic acids.
Bromides.....	All, except	Pb., Hg., Ag., Bi. and Sb.....	
Bromates.....	.....	.....	Solutions of bromides dissolve bromine.
Carbonates	Of alkali-metals	All others	Decomposed by acids.
Chlorides.....	All, except	{ Ag., Pb., BiOCl Hg.....	All decomposed by all acids, save HCN.
Chlorates.....	All .....	.....	{ AgCl sol. in sal. ammonia. PbCl sol. in hot water.
Citrates	Of alkalis	Others	Solutions of alkali-citrates dissolve salts of iron, bismuth, etc.
Cyanides	Of alkalis, mercury....	Others	All are soluble in water with excess of Pot. Cyanide and HCN.
Ferricyanides } Ferrocyanides }	Of alkali-metals and alkaline earths	Others.....	Decomposed by acids liberating HCN.
Gallates	Of alkalis	Others.....	{ Soluble in excess of acid. Gallic acid sol. in alkali citrates.
Hydroxides	Of alkalis, alkaline earths.....	Others	{ Aluminum hydroxide soluble in excess KOH or NaOH. Salts of organic acids, sugar, glycerine and gum retard precipitation of metal- lic hydroxides.

Relative Solubility of Substances in Water.

Compounds.	Those Soluble.	Those relatively not Soluble.	Special Remarks.
Hypochlorites....	All .....	.....	Decompose unless preserved in excess of alkali.
Hypophosphites.	Of alkali.....	Others	Prone to decompose — act as reducing agents.
Iodides	All, except	Ag., Pb., Hg. and basic iodides Bi. and Cu.	Decomposed by acids liberating Iodine.
Iodates .....	.....	Bismuthyl nitrate	Decomposed by acids liberating nitrous acid.
Nitrates	All, except	Those of Ag., Pb.	Soluble in dilute inorganic acids.
Nitrites	All, except	Others	" "
Oxalates.....	Of alkalis	All others	Strong oxidizing agents; decomposed by organic matter and reducing agents.
Oxides.....	Alkaline earths. ....	.....	Soluble in dilute acids.
Permanganates ..	All	Of other metals..	" "
Phosphates	Of alkalis	All others	" "
Salicylates	Of alkalis.....	Ba., Sr., Ca., Ag., Pb., Hg.....	" "
Sulphates	All, except	Others	" "
Sulphides	Alkali-metals	Others	" "
Sulphites.....	Alkali-metals	Others	" "
Tannates .....	.....	Basic tannate of heavy metals...	Easily decomposed by acids evolving H ₂ S.
Tartrates.....	Alkali.....	Others.....	Soluble in acetic acid, bleach vegetable colors, by giving off SO ₂ .
Valerianates	Most all	Iron, Zinc.....	All are very unstable.

Ampoules.—In the last few years a great many solutions of medicinal agents such as iron, mercury, arsenic compounds, alkaloidal salts, etc., have been prepared for injection hypodermically, intramuscularly, or intravenously and packaged by manufacturing pharmacists in sealed glass ampoules, each containing one dose.

When wanted for administration the ampoule is held by the smaller, drawn-out, fused end or stem and shaken so that all the solution is thrown into the oblong bulbar part; the stem, if not previously scratched, is marked with a sharp file; part of the stem is snapped off: the hypodermic needle attached to the syringe is passed into the solution in the ampoule, the ampoule is held upside down above the syringe and by withdrawing the plunger all of the solution is drawn into the syringe. It is important that the syringe, needle and solution all be sterile.

Some articles, such as camphor, may be dissolved in a fatty oil—olive, cottonseed, almond, etc.—and others, such as some of the mercury compounds, may be suspended in a fatty oil for administration hypodermically, etc., but in general water is the solvent for these preparations.

Serums, Vaccines, Bacterins.—Biological preparations do not necessarily fall within the groups of medicines that pass across the prescription counter in a drug store, but as a matter of convenience are usually associated with prescription work.

Since these articles are administered hypodermically or in some few instances, intradermally (smallpox virus) intramuscularly or intravenously,

it is exceedingly important that they be free from contamination and pass the required sterility test. As a matter of potency, it is important that they be administered before the "expiration date" named on the package.

The original package, if containing but one dose, should not be broken or opened until the moment of administration to the patient, and the contents may be withdrawn from the container in the manner described under "ampoules."

Packages containing more than one dose are usually closed with a soft rubber stopper, which can be punctured with a hollow hypodermic needle, through which a single dose can be drawn into the syringe.

It is not lawful to sell in interstate commerce a biological preparation unless it has been prepared and propagated in a laboratory licensed by the Secretary of the Treasury, acting through the Public Health Service and Hygienic Laboratory or, if intended for use in veterinary practice, licensed by the Department of Agriculture, acting through the Bureau of Animal Industry.

Various state laws and regulations have been made also, and in some instances these may supplement the Federal laws and regulations, but in all cases of apparent conflict, the Federal statutes prevail and govern.

It is the usual practice to keep biological preparations in a dark place where the temperature can be kept between 4.5° and 15° C. (40°—59° F.). Short exposure to somewhat higher temperatures is not injurious, especially in the case of bacterins.

b. Emulsions.

An emulsion is a liquid preparation containing a finely powdered insoluble solid or an immiscible fluid (usually oily) in a fine state of division, intimately mixed with and suspended more or less permanently in water, by the aid of an emulsifying agent, usually gum.

There are three principal classes of emulsifying agents, namely:

1. Gums.
2. Albuminoids.
3. Soapy substances.

Of the gums, acacia and tragacanth are most common, but chondrus, cetraria, quince mucilage, etc., are occasionally used. Of the albuminous substances egg and milk are good examples, although various vegetable ferments and other proteolytic bodies of animal origin could be used—emulsin, diastase, pancreatin, ptyalin, etc., may be used. Egg is very efficacious as an emulsifier, having great power and capable of use with a variety of substances; also milk if greatly condensed without use of heat, but both spoil rapidly and must be preserved with an antiseptic, or the emulsion consumed within a short time.

Soaps and saponins may be used to good advantage for emulsions to be used externally, but are not suitable for employment with internal remedies except in few cases. Alkalies act by first combining with fat or resin acids to form soap and the soap, in turn, acting as the agent for emulsification; hence they can not be used except with true fats, resins or oleoresins. Copaiba may be emulsified by using liquor potassa—but volatile oils can not.

Egg yolk and milk are *natural emulsions* of oils by aid of albuminoid agents; in the egg, *vitellin*;

in milk, the cream is held in suspension by *casein*. When casein is coagulated the cream separates as butter. In seed emulsions, oil is held in natural emulsion by the vegetable albuminoid ferment present. Gum resins have their resin emulsified by the gum present.

To prepare a seed emulsion, therefore, it is necessary only to take the seed freed from the pericarp and triturate with small portions of water, added at intervals, and when finished strain out all coarse particles.

A gum-resin emulsion is made from fresh, selected pieces of gum-resin by rubbing in a (warm) mortar with small portions of water gradually added, and when finished straining out the solid particles remaining. The principal gum-resin emulsions are those of ammoniac, asafoetida and myrrh, respectively, and since gum-resins are not capable of being powdered without drying them, whereby the volatile oil is driven off along with the water and usually the gum spoiled at the same time, it follows that *powdered* gum-resins are nearly worthless and should never be used for emulsions. But the great majority of emulsions to be prepared by the pharmacist are those of

1. Fixed oils.
2. Volatile oils.
3. Resins and oleoresins.

While emulsions may be made by aid of various agents, those most generally used and available under a greater variety of conditions are the gums. Gums may be used dry or in solution, as mucilage. There are many gums, but acacia is best and tragacanth follows in value.

Different processes are in use and while one person gets better results with a certain method of

procedure another succeeds better with a different method. "Men's opinions, like their watches, vary; no two are just alike, yet each believes his own." As with method of procedure so with proportions of gum oil and water.

Success in emulsion making depends principally upon a correlation of a *reasonable* method with a *reasonable* proportion, etc.

We give a process which will always ensure success if followed carefully, and reasonable proportions of gum oil and water used. Also a proportion which will always ensure success with a reasonable method.

Take

No. 1.		No. 2.	
Fixed oil....4	} or {	Volatile oil.....2	
Acacia.....2		Acacia.....2	
Water.....3		Water.....3	

Place finely powdered acacia in a *dry* mortar (any ordinary wedgwood mortar will answer), upon it pour the oil and stir until evenly mixed to a uniform, pasty mass and all at once add the water and immediately stir rapidly with the pestle (pressure not necessary), until a light colored, *uniform* paste results and a crackling sound is produced and no oil globules can be seen. This is *the emulsion*; it then may be diluted with water and other fluids added, but the first water is called water of emulsification and must always be added all at once and in not too great a quantity, but must be sufficient to dissolve the gum, and the mucilage so formed by the solution of the gum in water should be dense or thick.

One and a half times as much water as gum is a proper proportion—the proportion of water to gum is of more account than that of oil and water or oil

and gum. Since oils vary in properties it follows that some are more difficult to emulsify, requiring more gum than others less difficult.

The above proportion No. 1 will answer for *any* fixed oil—volatile oils are relatively more difficult to emulsify than fixed oils, hence see formula No. 2 has an amount of gum equal to the volatile oil, yet the proportion of water to gum is the same and should be in all cases. Many volatile oils are capable of being emulsified with far less gum, but the above proportion will suffice for *any* volatile oil.

Resins may be dissolved in volatile oils and emulsified, as are oleoresins, by using the same proportions as for volatile oils.

Tragacanth is very much stronger than acacia, making a translucent, viscid mucilage with thirty times its weight of water. This mucilage is not a solution, however, for tragacanth does not dissolve but absorbs a large amount of water; it follows that for substances very prone to separate or difficult to emulsify, such as heavy, solid powders, some fluids like chloroform, etc., tragacanth is used with advantage; also in oil emulsions that are to be dispensed concentrated or kept for some time.

The process is the same, but proportions vary, being:

Tragacanth .. 1	} or {	Tragacanth.. 1
Fixed oil.....16		Volatile oil.. 8
Water .....20		Water.....20

Again, as before, water is proportioned to gum and should always be about twenty times as much and a tragacanth emulsion should be stirred longer than one made with acacia in order to give the tragacanth time to absorb the water, which it does somewhat slowly.

Some favor this process:

Place dry gum in dry mortar.

“ oil over gum.

“ water over oil so that it does not touch the gum below, then rapidly triturate until emulsion is formed.

Others favor this process:

Take gum and add water to form a thick mucilage; then gradually, in portions, add the oil, thoroughly emulsifying each portion before adding more.

Both will give success if manipulation be perfect, but a novice is apt to fail with the first, and with the last it takes a very much longer time if the last oil be entirely extinguished.

The water of emulsification first added *must be water*, not syrup, not glycerine, not a solution of acid, alkali nor salt: these substances, alcoholic liquids, etc., should be added after the emulsion has been made and first diluted as far as possible with plain water.

Some profess to prefer making an emulsion in a bottle—we consider it a slovenly process, but it will answer with volatile liquids nicely. When an emulsion is to be so made, from dry gum, the oil should be placed in the bottle first and flowed over all parts of the surface; then the gum added and shaken until uniformly mixed, after which the water of emulsification is added and the whole again violently shaken until a nucleus or primary emulsion results, when it is gradually diluted.

Some substances, like phenols, etc., may first be mixed with a bland, fixed oil, like olive or almond oil, and afterward emulsified. Solid fats, waxes, etc., to be emulsified must be melted first, but, in general, heat hinders emulsification. With egg

yolk about two parts of fixed oil or one part of volatile oil may be emulsified. With condensed milk about ten times its weight of fixed oil.

Chondrus and cetraria jellies may be used to emulsify in the proportions of about one part mucilage to two of fixed oil or equal parts volatile oil. Chondrus "jelly" may be made by boiling a half drachm of the mass to an ounce of water, straining and adding one-fourth ounce glycerine or alcohol. First wash moss with cold water to remove salts, etc.

Saponin is used in the form of tincture of quillaya and while having emulsifying power sufficient to recommend it, its acrid toxic properties condemn it in medicines for internal use. The object of preparing emulsions is to overcome the disagreeable taste and get the substance in such form that it may easily be assimilated.

Emulsions should be dispensed in wide-mouthed bottles when thick and always should bear a "shake" label, and those prepared from milk or egg should further be directed to be kept in a cool place.

- R. Ol. Ricini.....f℥i.
- Syrup.....f℥ii.
- Acacia.
- Olei Gaultheria.
- Aquæ āā qs.....f℥viii.

M. Ft. Emulsio. S. ℥iii h. s.

Place the acacia ($\frac{8}{2} = 4$), 4 drachms, in a dry mortar, add the oil and thoroughly mix: ($8 + 4 = 12$; $\frac{12}{2} = 6$), so take six fluidrachms water and add *all at once* to the mixture, stir briskly until the oil disappears, a creamy liquid results and a crackling sound is produced; then add sufficient oil of gaultheria to

flavor and gradually add the remainder of the water, stirring after each addition, and lastly the syrup, and dispense with a "shake the bottle" label.

R. Ol. Terebinthina Canadensis.....f3i.
 Creosoti.
 Ol. Cinnamomi āā.....f3i.
 Sacchari Albi.....5ii.
 Ft. Emulsio ad.....f3xii.

S. 4 cc.t.i.d. for cough.

Place the balsam of fir in a warm, dry mortar, to render it more fluid; add to it the oil of cinnamon and creosote, add ten drachms of acacia and again mix, then add an amount of water equal to one and one-half times the acacia or two fluid ounces. Stir rapidly until primary emulsion is formed, then dilute gradually with water and lastly add the sugar and dispense with shake label.

B. Ol. Morrhuæ.....f5iv.
 Spt. Vini Gallici.....f5i.
 Tinct. Vanillæ.....f3i.
 Ft. Emulsio Cum ovi ad.....f5xii.
 S. as directed.

Into a mortar put the yolks of two eggs, or the whole eggs may be used, reduce to a uniform liquid by beating or stirring, next add the oil in one portion and triturate until an emulsion results; transfer to a bottle; to the spirit and tincture add water enough so that the three will increase the volume of the emulsion to twelve fluid ounces. This should be labeled "Keep in a cool place" and will be apt to spoil, hence antiseptics are sometimes added to preserve the egg.

R. Bitter Almonds..... 60 grams.
 Water to make.....1000 Cc.
 Boric Acid..... 20 grams.

Mix. Label "Almond milk for softening and whitening the skin."

Soak the almonds in tepid water until the skins come loose. Remove the skins and to the blanched almonds add a small amount of water and beat to a smooth pulp, then add the water in portions, triturating well after each portion is added, lastly strain out the almond pulp and add the boric acid.

Patent emulsifying agents are to be avoided, being either worthless or harmful medicinally.

No competent pharmacist need use them.

No conscientious pharmacist will use them.

c. Mixtures. The term mixture formerly embraced seed and gum-resin emulsions, but now the Pharmacopœia uses the title for a class of preparations containing insoluble matter in a fine state of division suspended in a watery fluid. Twenty-two are listed in the U. S. P. and N. F.—all best when prepared extemporaneously. But the pharmacist understands the term to have a much more liberal meaning, and therefore he usually designates all liquids not transparent solutions nor emulsions as mixtures. The prime object is to get a *uniform* liquid preparation containing the insoluble substance in a *fine* state of division and to accomplish this and secure a mixture which, when shaken, will be *uniform*, often requires the best skill and ability possessed. Some solids mixed in a certain manner form gritty lumps or glutinous masses with water or other fluids, yet mixed in different order, will give no trouble. Again, two substances are to be combined which will give a precipitate, but if brought together properly will give a fine, bulky precipitate which can be, by shaking, uniformly distributed, while another method would give a

precipitate, dense, heavy and uneven. Again, two liquids to be mixed, which are incompatible and would result in anything but the object desired, may however, by use of a neutral protective agent or diluent, be combined without trouble. Alcoholic tinctures of resinous substances prescribed with water or watery solutions of saline salts or acids will make very unsightly mixtures, with lumps of precipitated resin if improperly mixed, but often can be mixed in proper manner, giving a uniform emulsion-like liquid. Solids entering into a mixture should be in fine powder and the mixture so prepared that uniform dosage may be had and they always should bear a "shake" label when dispensed.

d. Waters are water solutions of volatile substances, usually gases or volatile oils.

Gases are soluble in water in varying proportions, depending partly upon the water being kept cold and the gas forced into it under pressure during agitation. Volatile oils and other aromatic substances are soluble to a slight degree. Usually volatile oils are soluble in about the proportion of $\frac{1}{10}$ of one percent. and this solution can be effected in various ways. All depends upon bringing the oil particles, in a fine state of division, in contact with the water, and this division is effected by distributing the oil on cotton or triturating with an insoluble *dry* powder and then mixing with water, or the water may be made by distillation. Distillation is not practical for the dispensing pharmacist, so the distilled waters, plain as well as the aromatic, are usually purchased from the distiller, who usually obtains it as a by-product from distilling volatile oils.

By percolating water through cotton charged with oil a good water can be obtained, if the oil be well distributed over a relatively large bulk of cotton. When an insoluble powder is used upon which to distribute the oil it should be dry and *insoluble* in water and *neutral* in action toward water or volatile oils. Magnesium carbonate should not be used because it is not neutral, nor is it insoluble, it usually contains magnesium oxide and many oils are colored by its reaction. Calcium phosphate, precipitated, is good. Barium sulphate is more nearly insoluble, but care must be taken that none passes through the filter paper. Another good method is to take filter paper pulp dried, and drop the oil upon it and place in a strong bottle and pour on boiling water. All waters should be kept filtered, clear from deposit and no oil globules should be allowed to pass through the filter; this may be avoided by wetting the paper before beginning to filter the aromatic water. Aromatic waters often spoil and hence should be watched that they be in good condition.

e. Mucilages are concentrated solutions of *gums* in water. There are two principal kinds of gums, *arabin* gums (example, acacia) and *bassorin* gums (example, tragacanth). Arabin gums are soluble, forming a clear, dense, viscid mucilage with water in the proportion of one part gum to one and a half water, or less water.

Bassorin gums absorb large amounts of water, swell and form a sticky, pasty mass which is opaque, or, if very dilute, translucent. Under the influence of moderate heat for some time the gum is altered and partly dissolves.

Other gums are very little used. The general impression is that mucilages all spoil very rapidly and various means are adopted to prevent them from souring. They do spoil readily, particularly when dilute, but if select gum arabic be dissolved in equal parts of distilled water, or not more than one and a half times as much water, and the bottle covered with a cloth of coarse mesh, or absorbent cotton, it may be kept fairly well. We have kept it six months during summer weather with no trouble, and never using anything to preserve but the density of the solution. Of course dirty mucilage would be apt to develop vegetable growths from spores present in the foreign matter. Mucilages are not used for any medicinal effect since they are neutral and inert, but they are used to emulsify oils and prevent precipitation in some cases and to suspend insoluble powders, etc., in watery liquids, and as demulcent vehicles.

f. **Infusions** are dilute, watery extracts of vegetable drugs prepared by infusion, maceration or percolation. They are very indefinite preparations because the process of extraction is not such that all the strength of the drug is obtained in the finished preparation. They are supposed to represent five percent. of drug unless the strength is otherwise specified.

Except with drugs containing a principle soluble in hot water, which principle is not desired (cinchona), or a substance is desired which would be volatilized or lost by using hot water (wild cherry) infusions are made by pouring boiling water upon the plant drug not in *fine* powder, and allowing it to infuse until cold, or a stated length of time, when the liquid is strained and water

poured through to make up the required volume. Infusions should be prepared from *coarsely ground, cut or bruised* drug but not from finely powdered drug.

g. **Decoctions** are weak, watery extracts of vegetable drugs *similar to infusions* in strength and mode of preparation, but are prepared by pouring *cold* water upon the drug, then *boiling* for fifteen minutes, or a stated time. Unless otherwise specified decoctions are made of five parts drug to one hundred parts of finished preparation, but the process differing in that the *decoction is boiled*, ensures different results and therefore they are different in properties and made from drugs of different nature. The prolonged contact at an elevated temperature alters some of the plant starches and renders them soluble, hence decoctions are thick, mucilaginous liquids usually having demulcent properties. Neither infusions nor decoctions are permanent preparations, both having a tendency to spoil rapidly. This tendency can be overcome by adding alcohol, fifteen percent.; but, being preparations weak in medicinal properties, this addition is not advisable as alcohol would probably be the more energetic in most preparations.

h. **Syrups** are concentrated solutions of sucrose sugar in water or liquids containing water and may or may not contain medicinal matter or flavoring agents.

Syrups are very important pharmaceutical preparations and are important because of their property of aiding to overcome the disagreeable taste of many medicines by virtue of the sweet taste of sugar and *also* the ability of sugar and sugar

solutions, when sufficiently dense, to *prevent fermentation* and *other chemical reactions*, thereby acting as valuable preservatives without being objectionable medicinally.

Sugar is practically inert medicinally, is used by the system as food and when taken in great excess is promptly eliminated without bad effects. Sugar is not antiseptic, but in dilute solution very prone to "sour;" however, when the solution is quite dense it acts as a negative antiseptic by excluding all the air from the liquid and protecting the molecules of the matter from contact with oxygen of the air, which is always necessary for any spontaneous oxidation. The amount of sugar necessary to act as an effectual preservative, of course, varies with the nature of the substance, but is never greater than the amount necessary to form a *saturated solution* with *all the water* present, with organic substance about sixty-five percent., but if volatile oils be present in quantity the amount may be less because volatile oils are antiseptic. Other antiseptic agents present will often permit of considerable reduction of the amount.

When syrups begin to ferment they are worthless and even harmful as medicinal agents or vehicles. Syrup or simple syrup is therefore an important preparation and often gives the pharmacist trouble, but should not and will never if only clean utensils be used and the syrup be made sufficiently strong in sugar. There are many ways of preparing simple syrup but only one *best* way and that consists of percolating cold water (which has previously been boiled or distilled) through clean sugar so that the percolate be a saturated solution of sugar in water. Loaf sugar is the best, but clean, granulated sugar will answer and syrup made this way will be free

from dust, bluing, etc., and will keep forever at any natural temperature; will stand a very low temperature without crystallizing and may be kept in a warm or cool place. The percolator should have a large apex and the apex filled with a *clean*, coarse sponge upon which should be a thick layer of absorbent cotton. The sponge and cotton should fill the apex and occupy a space equal to about one-twentieth of the height of the percolator in order that percolation may be rapid. Neglect of this detail has driven many a short-sighted pharmacist to make syrup by boiling, which always is liable to invert some sugar, increasing the liability to fermentation.

Making syrup by cold agitation is the next best way, but the syrup then must be filtered to remove paper, dust, bluing, etc., always present in sugar to a small extent. The percolation filters the syrup while it is proceeding.

Flavoring syrups are made either by dissolving the flavor in syrup or in the water used to make the syrup or by mixing fruit juices, etc., with syrup.

Medicated syrups are usually made by mixing the medicinal agent in concentrated solution with simple syrup or dissolving sugar in a solution of the medicinal substance.

Physicians often prescribe small quantities of syrup with large quantities of watery liquids and in summer weather it is quite possible for such a prescription to be partly used, then to ferment and become very deleterious. Syrup and watery solutions, containing insufficient sugar should be kept from heat and air. Sugar aids water as a solvent for some substances, lime, magnesia, borax, etc., and prevents many precipitations if judiciously

used, but it can not be used indiscriminately as an excipient.

i. Honeys are really syrups made from medicinal agents and honey by solution or mixing.

Honey acts like syrup but is not so sweet, the peculiar flavor, though due to foreign matter, is often in itself a desirable flavoring agent.

j. Elixirs are aromatic spirits, sweetened with sugar and diluted with water and are used as vehicles for masking the bad taste of medicines and presenting them in a form agreeable to sight as well. Elixirs consist of sugar, alcohol and water in various proportions, and small amounts of flavoring agents and medicinal matter. In addition, some are colored, but all should be perfectly clear, bright and *transparent*. These conditions may be easily imparted by proper manipulations in combining the different materials.

Elixirs should contain about twenty-five percent alcohol and twenty-five percent. sugar and flavor to suit. Sweet wines are often used as a component of elixirs; when so used their alcoholic strength should be fortified or increased to twenty-five percent. also the amount of sugar increased. The basis of all elixirs should be the aromatic elixir of the U. S. P. Since elixir is used as a vehicle diluent or filler and mixed with all kinds of substances, watery, acid, saline, etc., the volatile oils sometimes separate: especially are they liable to do so if the proportion of alcohol is lessened or that of volatile oils increased. The best way to make a nice, clear elixir which will not separate the volatile oil is this: Instead of dissolving the oils in alcohol, mixing the syrup and lastly the water, take the oils, distribute upon finely powdered barium sulphate or talc, make an

aromatic water *with it and all of the water*: in this water dissolve the sugar by percolation and lastly mix the alcohol. This will remain clear and transparent, very seldom separate oil and can be made more readily as the water will filter much more rapidly.

Elixirs may be colored red with cudbear or bright red with cochineal; yellow with turmeric, green with chlorophyl solution; olive green with chlorophyl and turmeric. See also paragraphs on Vehicles and Diluents.

k. Spirits are solutions of volatile substances in alcohol or alcoholic liquids. Most spirits are solutions of volatile oils in alcohol and when mixed with watery liquids are liable to separate the oil. Sometimes this separation may be avoided by slowly adding the watery liquid to the spirit instead of vice versa. Spirits should be kept in tightly stoppered containers and should be clear and transparent and protected from strong sunlight.

LIQUIDS. For external use.

a. Collodions are solutions of gun cotton in a mixture of ether and alcohol, or the same in which medicinal agents are dissolved.

Gun cotton is not soluble in alcohol nor in ether; but in a mixture of the two in the proportion of three of ether to one of alcohol it is very soluble. Collodions are to be applied to the surface, where the fluid portion rapidly evaporates leaving a serous and impervious film which excludes foreign contaminating matter, and because of the contractile power exerted during evaporation collodion is used to draw and hold the lips of fresh cuts in place

as well as to hold antiseptic dressings in place effectively.

Collodion is incompatible with watery fluids, precipitating the cotton. They are also inflammable and caution is necessary in handling. In medicating collodions the medicament should be dissolved in the smallest possible amount of alcohol, ether or a mixture of them, and then added to the collodion, unless the substance be very soluble in the collodion. Collodion should not be measured in the ordinary graduate, but in the bottle and dispensed in *cork*-stoppered vials. It dissolves rubber stoppers and glass-stoppered bottles are not secure against evaporation.

b. Liniments are liquid preparations of an alcoholic, oily or soapy nature to be applied externally and intended to produce anodyne, stimulant or vesicant effects—a very popular method of medication but very uncertain and ineffective. From a pharmaceutical standpoint they are also very indefinite beyond the liniments of soap, chloroform, soft soap, camphor and ammonia. Prescriptions for liniments may contain most any medicinal substance. Therefore in their preparation we can only use our best judgment, treating them as solutions, spirits or mixtures. Liniments should always bear the "*external use only*" label.

c. Glycerites are solutions of medicinal agents in glycerine or mixtures of them with glycerine. Glycerite of starch is used as an ointment base and excipient. It is made by heating eight parts glycerine to 140° C. and pouring into this a mixture of ten parts each of starch and water, continuing digestion at this temperature until the starch grains in the

presence of water swell to bursting, become altered and, entering into partial solution, form a thick, mucilaginous paste with the glycerine. This transformation must be complete throughout and care must be used that the temperature be not above 144° C. else the glycerine may decompose; particularly is this decomposition liable to occur if a naked flame be used, and also the starch will be liable to char and blacken.

Glycerine is largely used as a vehicle both in internal as well as external medication. It has a strong affinity for water, and when applied absorbs water through the body membranes causing depletion of adjacent tissues; it has antiseptic properties and is, therefore, valuable in preventing fermentation and often will prevent chemical action between different substances associated in a liquid; it is a valuable solvent for certain substances, and being a dense liquid like syrup it excludes air, preventing oxidation of some chemical substances.

d. Enemas are liquid preparations for injection into the bowels either to cause evacuation or to introduce nourishing or medicinal matter; they should always be prepared with distilled water and for introducing nourishment should be mucilaginous in consistence.

For alvine evacuation enemas may be made alkaline in reaction by a small amount of soap, but should be *filtered* in all cases and are to be warmed to body heat before being administered.

e. Gargles are liquid preparations to be applied to the mouth and tonsils by being gargled. Gargles are prescribed, prepared of proper strength for gargling and also to be largely diluted before being

used. Care should always be used to distinguish this to the patient; the finished or diluted may bear a label "*gargle*," but the other should not, but instead, "*caution: external use only*" preceding the physician's directions.

f. Sprays are solutions of medicinal agents in a bland liquid, water, glycerine and water or oil, and intended to be sprayed with an atomizer or nebulizer into the nostrils or mouth to protect or act through the mucous membrane. Fine oil sprays or nebular vapors are sometimes to be drawn by inhalation into the bronchii and lung cavities. Oil sprays should be absolutely free from water, the medicament in perfect solution and the oil base bland and neutral. Light hydrocarbon oils have come into extensive use for this purpose under various names, but have very slight solvent properties. Many substances which are soluble with difficulty in petrolatum oils may be brought into solution in almond oil, olive oil or pure oleic acid and mixed with the mineral oil afterward. Care should be used against rancid oil or oleic acid. Alkaloids form oleates with oleic acid which are soluble in oil. When alkaloidal salts are prescribed in oil sprays the corresponding amount of alkaloid usually may be taken unless the physician objects. Watery sprays should be filtered so that no undissolved matter be present to clog the tubes of the atomizer. The National Formulary gives the name "*Nebula*" to this class of preparations.

g. Inhalations are fluid medicines containing medicament to be volatilized by heating or putting on hot water and inhaling the vapor; or the medicine is put into an inhaler and air is inhaled through the liquid, becoming charged as it goes through

and carries the medicinal vapor to the bronchii and lungs. They are prepared in water solutions usually, but sometimes are very complex mixtures containing resins, oils, iodine, phenols, etc. Alcohol should never be used in an inhalation unless prescribed.

h. **Baths** are liquid preparations containing medicinal matter to be applied to the skin of the whole body by being added to water with which the body is laved. Since they usually contain medicine, which is alkaline, acid or strongly disinfectant they all are apt to be irritant or corrosive in an undiluted condition. Care should be used to always affix a "caution" label.

3. Tinctures, wines, vinegars, fluid extracts and oleoresins are not, strictly speaking, ever prepared extemporaneously, but require very careful consideration of plant physiology and pathology, plant products, solubility and manipulative details different from those employed at the prescription counter. Anything like a careful consideration of these preparations would require much more space than at our disposal here.

INCOMPATIBILITIES.

A pharmacist understands incompatibility to mean an *unfitness* of drugs for association in a medicine. This unfitness may be because of some inherent tendency of the substances to remain "unmixed" or rather to separate after having been combined, or to combine chemically, changing their properties and giving a new substance having objectionable or negative properties, or may be due to the fact that the medicinal effect would be entirely different from that desired. Therefore we may, for the purpose of studying in detail, divide incompatibility into three cases, viz. :

- a. Therapeutical.
- b. Pharmaceutical.
- c. Chemical.

a. Substances are *incompatible* when *unfitted* for association, in a medicine; that is to say, that many substances which, when associated, give a result not ideal, are, nevertheless, *not unfitted* for association in a medicine, so long as good results are obtained from their administration. Two remedial agents having directly opposite therapeutic properties and in sufficient proportion would, of course, tend to neutralize each other and give a negative result; such would, of course, be an exaggerated example of therapeutic incompatibility; but sometimes antagonistic remedies are prescribed together, one subordinated to the other and intended as a corrective to modify the action of the other. As a rule, the question of therapeutics is one which prop-

erly concerns the physician instead of the pharmacist and while the druggist should *always* be careful that no dangerous dose or combination should escape attention, all he can do is to call the physician's attention to the fact, and do so with discretion lest in zeal he may commit himself to error.

Overdoses and poisons are not a part of the subject of incompatibility, but are treated in the chapter devoted to Toxicology and Posology (page 192). Many theoretical so-called incompatibilities given in text-books are nevertheless disregarded by the average practitioner, who will prefer his results to another's theory. Substances which unite to form new and objectionable compounds having different medicinal effects are incompatible chemically, since not the original, but the new substance is the one producing the effect.

b. Pharmaceutical or physical incompatibility is manifestly a case of immiscibility, insolubility or tendency to separate when mixed, but yet *without chemical reaction*, and this property of separating or that of not dissolving is not considered sufficient to *unfit* the substances for association unless after using skill and dexterity the substances still can not be combined so that even dosage be made feasible. A clear solution should be made where possible, but if a clear solution can not be obtained an "even suspension" will answer in many cases.

The mere fact of one substance being insoluble in another is not always evidence of incompatibility, provided that with reasonable care the different ingredients can be diffused so that the doses will be of the same amount.

If, however, the tendency of liquids, or a solid and a liquid, to separate is so marked as to prevent the measuring of a dose before separation interferes,

these substances may be considered *incompatible* and a remedy applied, or if no remedy will suffice they should not be mixed.

There are four kinds of physical incompatibility illustrated, by

- (a) Alcoholic solutions, fluidextracts, tinctures, etc., etc., with aqueous liquids, the dissolved matter being precipitated by the change in the solvent or menstruum. Such precipitate will be *inert* or *active*. If inert, such as gum, starch or inert extractive matter, filter out the inert matter and dispense the filtrate, which will contain the medicinal matter.
- (b) Mucilaginous and albuminous substances with strong alcohol, which precipitates gum and albumen.
- (c) Salt solutions in watery fluids, with strongly alcoholic liquids, the salt being precipitated, or when salt solutions are concentrated the alcohol being precipitated, forming a floating layer.
- (d) Alcoholic solutions of oils with watery fluids, the oil being precipitated.

Remedies.—Incompatibilities of this kind may be remedied in some cases or possibly avoided by

1. Order of mixing the ingredients.
2. Addition of protective solvents.
3. Emulsification or suspension by means of gums or other viscid substances—honey, glycerine, sugar, etc.

The order of mixing the ingredients is sometimes the most difficult problem in compounding a prescription; three general rules will apply:

1. When strongly alcoholic liquids are to be mixed with watery solutions or those weaker

in alcohol, dilute the stronger with the weaker alcoholic preparation and add the watery solution last; by this means a precipitate may either be avoided entirely or if it is formed it will be in a more finely divided condition so that it may be more readily diffused.

2. In cases of resinous tinctures and camphoraceous solutions when no protective is admissible, this order should be reversed and the solution poured slowly, or drop by drop added to the watery liquid, which must be stirred continually.
3. When oils or heavy insoluble powders are to be dispensed in a large portion of fluid it is desirable to emulsify them or incorporate with gum or some suitable agent so as to avoid separation.

Examples:

Take Mucilage of Acacia....1 part.

Alcohol.....2 parts. Mix.

Note that gum is separated from its solution by alcohol. No chemical action takes place, but the alcohol appropriates the water; however, dilute the mucilage with water two parts and a considerable amount of alcohol may be added without precipitation of the gum, if the alcohol be added slowly and the mixture agitated the while.

Take Oil of Almonds.....1 part.

Dilute Alcohol.....1 " Mix.

When fixed oils (except castor oil and alcohol) are shaken with water, alcohol, glycerine or mixtures of them, the oil breaks into fine globules and a seemingly uniform mixture results, but on standing the oil always separates.

Take Tincture of Benzoin...1 part.

Rosewater.....5 parts. **Mix.**

Resin is precipitated from the alcoholic solution by reason of alcohol being taken up by the water which rejects the resin. If the water be added to resinous tinctures in excess the resin separates in masses which gather and adhere to the sides of container; same result if all the resinous tincture be added at once to the water; but if the tincture be added drop by drop and the mixture constantly stirred a milk-like emulsion may be had which holds most of the resin.

Take Phenol.....1 part.

Water.....8 parts.

Glycerine.....1 part. **Mix.**

Carbolic acid added to water sinks to the bottom undissolved; glycerine added will not dissolve it; water added to carbolic acid (in excess) and lastly glycerine added give same result, but carbolic acid mixed with equal parts of glycerine forms a solution which, in turn, is soluble in water in any proportion.

Take Tincture of Benzoin ... 3 parts.

Mucilage of Acacia 5 "

Water10 " **Mix.**

If resinous tinctures be first mixed with mucilage or finely powdered dry gum and water then added, the resin is precipitated in a finer state of division and the viscid mucilage tends to prevent or retard separation. Glycerine or syrup often gives similar results.

Take Soluble Pyrophosphate of Iron.. 1 part.

Any Alcoholic Tincture10 parts.

Mix. No solution results, but by taking sufficient water to dissolve the salt and dilute the alcoholic tincture, a clear solution will result. **General**

practice of this procedure should be with physician's permission unless therapeutic effect will surely be that indicated; that is, the druggist should be careful, ordinarily, not to alter a prescription from the way it was written unless with permission of physician or unless a *better* result be *surely* attained by the change.

Adding inert solvent to such mixtures, if *strengths be not changed* and a *beneficial result obtained*, is permissible even without consulting the physician. It is usually advisable to inform the prescriber of the change at the earliest opportunity if he was not consulted before the prescription was dispensed.

Another illustration:

Take Red Mercuric Iodide... 1 part.

Water49 parts. Mix.

No solution, but potassium iodide mixed in proportion equal to that of mercuric iodide acts as a solvent, and should be used.

Take Bismuth Subnitrate....12 parts.

Water23 " Mix.

Bismuth subnitrate is not soluble in water, is a rather heavy powder and liable to settle to the bottom. A little powdered tragacanth, five grains to fluid ounce, would enable a uniform mixture to be made which would not separate. By careful observation while dispensing prescriptions of this nature, experience can be gained which will be of more value to the dispenser than anything that can be learned from a book.

Take Fluidextract Hydrastis.

Citrate of Potassium, of each... $\bar{5}$ ss.

Spirit of Nitrous Ether..... $\bar{5}$ iii. Mix.

If salts like citrate of potash and others very soluble in water but not soluble in strong alcohol be mixed with liquids containing both alcohol and water the salt abstracts the water and forming a dense solution sinks to the bottom, while the alcoholic layer floats. They will not mix. In such cases the physician will usually give permission to add water to make perhaps a double volume, clear solution, which may be directed in twice the sized dose.

Take Fluidextract of Pichi..... $\overline{3}$ ss.

Water $\overline{3}$ iiss. Mix.

The resinous fluid extract would precipitate so that a very unsightly and uneven mixture would result, but if five grains of powdered tragacanth be first shaken in a bottle with the fluid extract, the water will form with it a mucilage which emulsifies and retains the resinous principles in suspension.

4. **Chemical Incompatibilities** are those manifested by chemical reaction resulting in decomposition of one or more agent with formation of different compounds.

This class is the most important and the pharmacist is morally and legally accountable for their neglect. They are very persistent and almost if not quite impossible to overcome and avoid. The knowledge of chemistry is quite essential to the study of chemical incompatibilities.

The rules to be observed in case of physical incompatibilities apply here also.

Recognition of chemical reaction can be effected by evolution of gases, change of color or appearance of a precipitate. Chemical reaction occurs in dry powders as well as in the presence of liquids, though it progresses more slowly in the dry.

Incompatibilities cannot always be foretold, but certain rules or laws of chemistry govern them, and the result is always the same under like conditions.

In chemical reactions the strongest positive radical tends to unite with the strongest negative radical present.

Double decomposition will not occur between solutions of two salts, unless, by the interchange of the two baselous radicals a substance will be produced which is either insoluble or volatile.

When a solution of a compound is brought in contact with a solution of another compound, and, by an interchange of radicals, an insoluble compound will be rendered possible, that compound will be precipitated.

When dry heat is applied to a mixture of compounds, if any volatile product can be formed by double decomposition, that volatile compound will be formed.

Most cases of chemical incompatibility arise from the formation of insoluble compounds, hence the importance of the subject of "solubilities."

Yet many prescriptions call for drugs which, when mixed, react, producing a substance insoluble, when the insoluble substance is the object of the combination, or a reaction may produce a soluble salt whose effect is desired and the insoluble substance be not wanted. Again, a combination may produce a gas, and the gas may be desired in the mixture; or the gas may be not wanted. Many substances insoluble, and made by precipitation, diffuse much more readily when freshly made; and seem to have better effects when given in the fresh condition: hence prescriptions for substances which react to produce insoluble, new compounds should be so mixed in compounding that a *fine* precipitate

will result and the mixture dispensed with a "shake the bottle" label. Again when, through oversight or other cause, the physician orders a combination which produces or may produce an *insoluble* compound and the formation of the compound be not the object of the physician, but a valuable part of the medicine, it becomes all the more necessary to so prepare the mixture that the precipitate may be evenly diffused, and to dispense with a "shake" label.

However, it frequently happens that medicines are prescribed together which separately, produce effects desired simultaneously, but when combined chemically their product has an entirely different effect. Prescriptions which produce dangerous or undesirable products by all means should not be dispensed, and if the druggist be in doubt common sense will dictate that he "parry for time" and dispel the doubt by consulting the physician.

The subject of chemical incompatibilities is as limitless as chemistry itself almost, but between the extremes of theory and speculation on one hand and indifference and ignorance on the other a pharmacist should ever seek the happy medium course and try to distinguish between the "incompatible" combinations which are permissible and those which are not permissible, the guiding principle being his duty that no prescription be compounded when harm or dangerous risk would follow, but under all circumstances to protect the patient, the physician and himself by discretion and an honest and honorable course in case of error or oversight.

Nothing could do a druggist more harm in proportion to its magnitude than an indiscreet reminder to the physician under such circumstances. How embarrassing, should the physician have occasion afterward to correct the druggist! All mortals err!

Following is a list of the more common substances considered incompatible under ordinary conditions:

Incompatibles.

Substances.	Incompatible with	Remarks.
Acacia in solution.....	Alcohol, borax, lead salts, ferric salts, etc.....	Citrates of alkalis tend to prevent gelatinization by ferric salts.
Acetanilid.....	Nitrites in presence of acids, alkaline hydroxides.....	Tends to liquefy with chloral hydrate, resorcin, thymol, phenol, antipyrin.
Acids.....	Alkalies, alkaloïds, carbonates, hydroxides and oxides of metals, salts of weaker acids, pancreatin, casein, albumen, diastase.....	Salts formed may be desirable in some cases.
Alcohol.....	Active oxidizing agents as a rule. Albumen; acacia if strong alcohol. Metallic salts precipitate from solution.....	Forms iodoform with iodine and alkali hydroxide.
Alkaloids.....	Alkalies, iodine, iodides, bromine, bromides, tannin, mercuric chloride, potassium permanganate and oxidizing agents.....	Ppt. soluble in alcohol usually, form water-soluble salts with mineral acids, also acetic, citric—other organic acids give salts not soluble in water but soluble in alcohol.
Amyl-nitrite.....	Alcohol, oxidizing agents, light, alkalis.....	Strychnine, digitalis, morphine, chloroform, belladonna, physiological antidotes.
Antipyrin.....	Acids, alkalis, nitrites if free acid present, haloid salts, tannin, and in general behaves like alkaloïds	Oxysulphide explodes with reducing agents; opium, alcohol, ether, physiological antidotes.
Antimony salts.....	Albumen, mucilage, tannin.....	Gives off CO ₂ from soda bicarb.
Bismuthyl-nitrate.....	Sodium bicarbonate, tannin, sulphur.....	All barium salts poisonous.
Bismuth subgallate.....	Strong acids.	
Barium salts.....	Salts of sulphuric, phosphoric, tartaric, tannic, carbonic acids.....	

Incompatibles.

Substances.	Incompatible with	Remarks
Butyl-chloral hydrate...	Alkalies, antipyrin, camphor, thymol, menthol, phenol, decomposed by light in aqueous solution.....	Strychnine, caffeine, atropine, antidote.
Calomel.....	Acids, alkalies, oxidizing agents in general, antipyrin, iodine, iodides, sulphides, chloral.....	
Carbolic acid.....	Collodion, acetanilid, albumen, aqueous solutions of gelatine, oxidizing agents.	In practice calomel often given with acids, chlorate of potash, etc.; if allowed to stand with these in presence of moisture, however, becomes oxidized.
Chloral hydrate.....	Calomel, hot water, alkalies, organic salts of alkalies, permanganate of potash, alcoholic liquids if concentrated.....	
Chloralamid.....	Alkalies.	Hydrate chloral keeps for years in <i>weak</i> alcoholic solutions without loss of medicinal virtues.
Creasote.....	Nitric acid, oxidizing agents.	
Diuratin.....	Strong acids.	With alcohol and alkalihydroxides forms iodoform.
Euorphen.....	Oxides of metals, starches and fats, salts of mercury.	
Essential oils.....	HNO ₃ and oxidizing agents, iodine.	Odor overcome by balsam of Peru, oil turpentine, anise, eucalyptus, bergamot, roasted coffee.
Fixed oils.....	Strong alkalies, iodine.	
Ichthyol.....	Acids, alcohol, alkalies, except ammonia, alkaloids, metallic salts.	
Iodine.....	Fats, volatile oils, carbolic acid, sulphurous acid and its salts, metallic salts, tannins, starch, ammonia, alkalies.....	
Iodoform.....	Strong alkalies, mineral acids, nitrates, nitrites, tannin, oxidizing agents.....	

Incompatibles.

Substances.	Incompatible with	Remarks.
Iron.....	Alkaloids, oxidizing agents, tannins, metallic salts, acids.	Normal lead acetate miscible with acacia, basic al-ways precipitates.
Iron salts.....	Alkali-carbonates, hydroxides, tannins, mucilages.	
Soluble lead salts.....	Opium, lime water and hydroxides, chlorides, iodides, bromides, sulphates, gums.....	
Opium and preparations	Tannins, metallic salts, iodine, chlorine water, etc.....	
Pepsin.....	Alkalies, alcohol, tannin, phenol, mercuric chloride.	Strychnine, caffeine and atropine, physiological antidote.
Pancreatin.....	Acids, alcohol.....	
Phenacetine.....	Strong acids, strong alkalies, oxidizing agents, carbolic acid, chloral hydrate, butyl chloral	
Permanganates.....	Fats and volatile oils, alcohol, glycerine, alkalooids, sulphur, sugar, charcoal, tannin, and all organic bodies in presence of heat or moisture, H ₂ O ₂	
Peru balsam.....	Sulphur, iodoform.....	Detonates violently if triturated with force with some of these in dry. Solidities.
Salicylic acid..... Salicylic acid, acetyl.. }	Iron compounds, oxidizing agents, alkalies.....	
Salol.....	Strong alkalies, camphor, phenol, thymol, resorcin, monobromated camphor.	Alkali citrates, phosphates, and acetates increase solubility in water.
Strontium salts.....	Carbonates, phosphates, oxalates, sulphates and hydroxides.	
Tannin.....	Alkalies, iron compounds, lead salts, alkaloids, salts of mercury, bismuth salts, oxidizing agents in general.	
Thymol.....	Camphor, salol, chloral, menthol, resorcin, acetanilid, phenols, resins, oxidizing agents, nitrates, iodine.	

℞ Antipyrini gr. xxx.

Liqu. Am. Acetatis

Spir. Æther Nitrosi.....aa f̄i. M.

In the above prescription antipyrin will be decomposed by the ethyl nitrite in presence of the free acid in the spirit of mindereris—a characteristic green color is produced. This color is quite distinctly green and will occur with antipyrin and spirit nitre alone, only when the nitre is old or spoiling; fresh neutral spirit of nitre does not produce this color, hence the above reaction is a good test for both spirit nitre and antipyrin.

Take Salicylate of Sodium.....̄ii.

Water.....f̄viiss.

Tinct. Iron Chloridef̄i. Mix.

A deep, reddish violet color, due to the formation of ferric salicylate, is produced. A test for iron, also salicylic acid.

Take Infusion Cinchona.....f̄vi.

Mercury Bichloride.....gr. vi.

Potassium Iodide.....̄vi. Mix.

Mercury bichloride with potassium iodide form mercuric iodide; with excess potash iodide a double salt is formed which precipitates all alkaloids; Alcohol in tinctures, etc., will redissolve the precipitate. If the diluent be all of watery nature, alcohol up to twenty-five percent. should be added to dissolve the precipitate.

Take Chloral Hydratēss.

Potassium Bromide.....̄ss.

Waterf̄iii.

Alcohol, qs.....f̄vi.

M. In concentrated alcoholic liquids chloral is decomposed, forming an oily, pungent, poisonous liquid called chloral alcoholate. This, however, does not form if the chloral is first dissolved in

water and alcohol is not present in too great a proportion.

Take Strontium Bromide..... $\frac{3}{4}$ ss.
Mixture of Rhubarb and Soda ... $\frac{1}{4}$ iv.
Mix.

Bicarbonate of soda decomposes the bromide of strontium forming sodium bromide and precipitates insoluble strontium carbonate and carbon dioxide is given off.

Take Ichthyol..... $\frac{1}{4}$ ss.
Water $\frac{1}{4}$ ss.
Alcohol.....qs $\frac{3}{4}$ viii. M.

Alcohol precipitates ichthyol.

Take Balsam Peru10 gm.
Sulphur.....10 "
Lard40 " M.

If balsam peru and sulphur be triturated or rubbed together, gritty granular lumps, very hard and objectionable, form. If part of lard is used to make an ointment with balsam and the remainder with the sulphur a smooth ointment can be made.

Explosive or detonating mixtures are sometimes inadvertently prescribed. The following, taken from actual prescriptions, are dangerous and some have caused serious accidents: Potassium chlorate and other chlorates with organic matter are, under certain conditions, capable of igniting the matter. If water be absent and the substance be of a combustible nature an explosion is very apt to result.

A mixture of hypophosphite of lime, chlorate of potassium, and lactate of iron exploded and nearly killed the prescription clerk who was compounding it.

Even the simple trituration of calcium hypo-

phosphite is dangerous. A young pharmacist was killed by an explosion which was caused by the shaking of a solution of this substance. Physicians not infrequently order a solution of chromic acid in glycerine. But when the acid is added quickly and all at once to the glycerine, a readily explosive substance may be formed.

The combination of iodine and preparations of ammonia must be made cautiously, as iodide of nitrogen may be formed, which explodes on the slightest touch. Indeed, one ought to be very careful in ordering and compounding mixtures in which easily reducible substances enter, such as the chlorates, the hypophosphites, the nitrates, preparations of iodine or ammonia, chromic acid, glycerine, permanganate of potash, etc.

Ex.:

1. R. Potassii Chloratis.
Sodii (Vel Calcii) Hypophosphitis.
Aqua.

M. Dangerous.

2. R. Potassii Chloratis.
Tr. Ferri Chloridi.
Glycerini.

M. If diluted with water no trouble will occur, but if not it may explode upon being warmed.

3. R. Potassii Chloratis.
Pulvis Catechu. M.

M. Dangerous.

4. R. Chromii Trioxidi.
Glycerini.

Diluted with water it is safe; not diluted it is dangerous, and if alcohol be brought in contact, flame usually results from the oxygen given off by the oxide, or "chromic acid."

5. R. Lactis Sulphuris.

Antimonii Sulphidi Auratum. .āā gr. iii.

Zinci Valerias. gr. i.

Potassii Chloratis " ii.

M. Triturate and it is sure to explode.

6. R. Antim. Sulphidi Aurat.

Sodii Chloratis.

M. Ignites upon slight trituration.

7. R. Potassii Chloratis.

Acidi Tann.

Glycerini.

Aqua.

M. Dissolve tannin in glycerine, the chlorate in the water and mix solutions.

8. R. Acidi Nitrici.

" Hydrochlorici.

Tinct. Nucis Vomicae.

Will explode after a while unless left unstoppered.

9. R. Argenti Oxidi.

Morphina Hydrochloridi.

Ext. Gentianae.

M. Will likely take fire after standing or while being mixed.

10. R. Argenti Nitratis.

Acidi Nitrici.

Alcohol.

Æther.

Will ignite if open; if confined will explode.

TOXICOLOGY.

General Remarks.—The responsibilities which are attached to the profession are manifested in the reading and dispensing of difficult and doubtful prescriptions, plainly and sometimes severely.

The competent pharmacist must be not only a man of mature judgment, capable of quickly deciding the best thing to be done under more or less obscure circumstances, but be able to inspire confidence on the part of a patron in what he says; he must, to be able to guard against over-doses, be thoroughly posted on Posology or the principles and rules of dosage. He must also have considerable knowledge of Toxicology or the subject of poisons, and their antidotes and also be able to tell in some cases the symptoms manifested by particular poisons so that he may be able to decide what to do and what antidote to give. This is one of the main subjects or branches of the Medical Science to be sure, but is quite important to the pharmacist also, because he is often called upon when a physician cannot be had for hours.

After a fatal dose of poison has been taken there is no time to be lost; the druggist is often called upon, being quickly and easily reached.

If he is not able to do something to save or relieve the sufferer, he is always blamed, usually in a severe measure.

The following treatise on the subject of dosage and Toxicology, while condensed, will be found quite thorough enough for the practical pharmacist; the more thoroughly it is mastered, the better will be the chances of the one who learns it to discharge the very responsible duties devolving on him, when brought in contact with emergency cases of poisoning by whatever agent or cause.

DEFINITIONS.

Toxicology is derived from two Greek words meaning "a treatise on poisons." It is the science which treats of the nature, symptoms, effects, doses and modes of detection of poisons.

A poison is a substance capable of destroying life when taken in a small quantity; but a substance which destroys life by mechanical means, e. g., powdered glass, is not, strictly speaking, a poison.

Poisoning is probably the most frequent of all the causes of violent death at the present day.

The effects of poisons are local and indirect.

(a) The local action of a poison is usually one of corrosion, inflammation, or a direct effect on the sensory or motor nerves, e. g., the corrosion of the stomach and bowels by direct contact of the mineral acids and alkalies. A poison may act both locally, by causing inflammation of the stomach, and remotely, on the brain and nervous system. Arsenic acts in this manner.

(b) The indirect actions of poisons are those which are produced on parts of the system remote from the part to which it was first applied, e. g., opium taken into the stomach, followed by narcosis.

POISONS IN GENERAL.

I. Symptoms in General.—There rarely fail to be shown signs of the poison taken. Poisoning may be acute or chronic; we will here only consider the former, as this only will interest the pharmacist at the time being. The symptoms which should lead to suspect acute poisoning are:

(a) Sudden occurrence of severe and alarming symptoms in a person previously in good health.

(b) Several members of a family suddenly taken ill simultaneously, after partaking of the same food.

(c) Rapid course toward a fatal issue.

II. Treatment in General.—If taken into the stomach,

(a) Empty the stomach by means of stomach pump if not a corrosive poison; stomach tube or emetics.

(b) Antidotes.

1. Chalk to neutralize mineral acids and oxalic acid.

2. Alkaloids are rendered less soluble if astringents containing tannin are given.

(c) Counter poisons:

1. As atropine, which acts in opposition to morphine.

2. All these are best administered hypodermically, as they are absorbed in a pure state and more rapidly.

- (*d*) Protect the stomach, if irritants were taken, by administering mucilaginous drinks, or some bland fixed oil.
- (*e*) Relieve pain with morphine, if not contra-indicated.
- (*f*) Relieve convulsions, if poisoned by strychnine, with:
 - 1. Chloroform.
 - 2. Chloral hydrate.

Poisons are {
I. Corrosive.
II. Irritant.
III. Neurotic or
IV. Gaseous.

I. CORROSIVE POISONS

Include:

Corrosive sublimate.

Concentrated mineral acids.

Oxalic acid.

Alkalies, viz., hydroxides of potassium, sodium, ammonium, as well as their carbonates.

Acid, alkaline and corrosive salts of metals.

Phenol or carbolic acid.

Symptoms.—

Metallic, acid or caustic burning sensations which extend from mouth to the stomach; this is rapidly followed by vomiting.

The vomit contains blood and tissue fragments.

Abdomen tender and extended by gas.

High fever.

Tissues of mouth more or less destroyed.

Death may take place in a few hours or in a few months from starvation brought about from stricture of the œsophagus.

Treatment.—

Gently wash out stomach with stomach tube.

Demulcents to protect the stomach, such as mucilages, oils, eggs and milk.

Opiates for pain.

CORROSIVE SUBLIMATE.

Symptoms.—

Metallic, coppery taste.

Deglutition retarded or swallowing prevented.

Burning pain of œsophagus and stomach.

Violent vomiting, first mucous, then bilious, then bloody.

Severe abdominal pain and tenderness.

Profuse diarrhœa, later small mucous bloody stools.

Breath fetid and offensive.

The urine is diminished or it may be suppressed; it may contain albumen or even be bloody.

Symptoms of collapse in two or three hours.

(a) Small, frequent, irregular pulse.

(b) Pinched, anxious face.

(c) Cold extremities.

(d) Fainting.

(e) Convulsions.

(f) Coma.

(g) Death.

Fatal dose and period.—

The minimum fatal dose (for an adult) can be taken at three grains, although much larger quantities have been taken and vomited or neutralized.

Life is usually prolonged, from one to five days, although death has occurred in one half hour.

Treatment.--

Promote vomiting by warm diluent drinks.

Albumen or white of an egg beat up with water given freely. The white of an egg will neutralize 4 grains of corrosive sublimate if taken at once. Do not use too much egg albumen as an excess will re-dissolve the compound formed.

In the absence of egg, gluten or wheat flour in the form of paste should be freely given.

Give milk freely.

Sweet oil.

Morphine hypodermically.

MINERAL ACIDS.

Symptoms.--

Same as corrosive sublimate except:

(a) Accompanied by more intense thirst.

(b) Constipation, sometimes.

(c) Coughing and difficult respiration.

Sulphuric acid stains the tissues black.

Nitric acid stains the tissues yellow.

Hydrochloric acid stains the tissues gray or white, with the formation of a false membrane.

Fatal dose and period.--

The fatal dose of sulphuric acid for an adult is a fluid drachm. Death usually occurs within 24 hours.

The fatal dose of nitric acid for an adult is 2 fluid drachms, although larger doses have been taken. Death usually occurs within 24 hours.

The fatal dose of hydrochloric acid for an adult is half an ounce. Death varies from a few hours to many weeks.

Treatment.—

Administer alkalies or their carbonates in solution in water or milk, such as the bicarbonate of potassium or sodium, chalk, whiting or soap.

Give diluent demulcents copiously, such as barley water, oil, flaxseed tea, etc.

Do not use stomach pump, as you may perforate the œsophagus or stomach.

OXALIC ACID.

Symptoms.—

Same as corrosive sublimate, plus:—

Acute pain in the back of the head.

Intense thirst.

Distressing cough.

Accelerated respiration.

Swelling of the tongue.

Depressed heart action.

Patient may suddenly fall unconscious immediately after taking the poison, with almost complete paralysis and numbness.

Collapse early and marked.

The urine contains crystals of oxalate of lime, albumen and tube casts.

Fatal dose and period.—

Three drachms usually prove fatal, although a drachm is known to have caused death.

It usually proves fatal within an hour.

Treatment.—

Chalk and magnesia mixed with milk.

Lime water and oil.

Opium, to relieve pain.

Alkalies and their carbonates should not be used because they form soluble poisonous compounds with the acid.

AMMONIA.

Symptoms.—

Abdominal pains.

Vomiting.

Bloody purging.

Suffocation may cause death.

Convulsions.

Coma.

Death.

Intellect may be clear to the last, or stupor and finally coma may develop.

Fatal dose and period.—

Death may occur in five minutes due to œdema of the larynx. If the patient survives several hours, recovery may occur, but death at times occurs from the organic lesions which have been produced.

Treatment.—

Weak solution of vinegar.

Lemon juice.

Citric or tartaric acid administered cautiously.

Demulcent drinks.

ALKALIES—OTHER THAN AMMONIA.

Under this heading come potassium and sodium hydroxides, their carbonates, lime, etc.

Symptoms.—

Like those of ammonia poisoning.

Fatal dose.—

Indefinite.

Treatment.—

Dilute vinegar or lemon juice should be used freely.

Give oil and demulcents freely.

Give opium to relieve pain.

Stimulants to overcome depression.

CARBOLIC ACID.

Symptoms.—

Same as the mineral acids, plus:—

Pupils are contracted.

Breath smells like carbolic acid.

Temperature falls rapidly.

Mouth white and hardened.

Labored respiration.

Coma and death.

The urine is of an olive green color.

Fatal dose and period.—

One-half ounce has several times caused death; a little over a drachm has caused death in one case.

Patients usually live from one to ten hours, but death may occur in ten minutes.

Treatment.—

Immediately give large doses undiluted whisky or other liquor, or dilute alcohol.

Stomach pump must be employed; emetics are useless because of paralysis of stomach.

Give sulphate sodium or magnesium freely.

Albumen and demulcents.

Syrup of lime.

Solutions of soap.

Oil useful for external applications.

Stimulate to overcome depression:—

Inhalations of oxygen.

Hypodermic injections of ether, etc.

II. IRRITANT POISONS.

Include:—

Metallic irritants and their compounds.—

Arsenic.

Lead.

Copper.

Zinc.

Nitrate of silver.

Phosphorus.

Iodine.

Vegetable Irritants.—

Elaterium.

Gamboge.

Aloes.

Colocynth.

Croton oil.

Animal irritants.—

Cantharides.

Symptoms in General.--

Slower in their action than the corrosives.

Burning pain in the mouth, throat, and œsophagus, with a feeling of pressure, then a burning pain in the region of the stomach, which is increased by pressure.

Thirst, nausea and vomiting.

Distention and tenderness of abdomen.

Profuse diarrhœa.

Collapse.

Death.

ARSENIC and COMPOUNDS.

Symptoms.—

In about half an hour the patient feels depressed.

Burning pain and tenderness on pressure in the region of the stomach.

Nausea and vomiting.

Purging, bloody and offensive.

Thirst.

Feeble, rapid or irregular pulse.

Cold clammy skin.

Bloody urine.

Convulsions.

Coma.

Death.

Fatal dose and period.—

Two grains is probably the minimum fatal dose.

Death usually takes place in from 12 to 72 hours.

Treatment.—

Emetics—sulphate of zinc, ipecac or mustard in water. Stomach pump if at hand.

Warm diluent drinks.

Hydrated sesquioxide of iron with magnesia given in large doses and frequently repeated.

Castor oil.

LEAD COMPOUNDS.

Symptoms.—

Like arsenic, plus:—

Blue line on gums where they join the teeth.

Lead in the urine.

Usually constipation instead of diarrhœa.

May have severe pain in the joints and limbs and cramps.

Lead colic pains in the region of the umbilicus, nausea, vomiting, etc.

Fatal dose and period.—

All the salts of lead are poisonous except the sulphate, which is insoluble.

Acute lead poisoning is rare, except by accident, but chronic lead poisoning occurs quite frequently.

The minimum fatal dose of all the salts of lead is very uncertain.

The fatal period is also very uncertain, varying from a few hours to a few days.

Treatment.—

Emetics, as sulphate of zinc.

Milk and white of eggs.

Sulphate of magnesia.

Castor oil.

COPPER COMPOUNDS.

Symptoms.—

Like arsenic, plus:—

Usually begin about fifteen minutes after taking the poison, but they may not appear for two hours.

The vomit is greenish or bluish.

Strong copper taste in the mouth.

Excessive salivation and bronchial secretions are characteristic.

Death may occur in a few hours preceded by syncope, paralysis, delirium and anæsthesia.

Jaundice is always present if the patient lives twenty-four hours.

Fatal dose and period.—

The fatal dose is uncertain, an ounce of the sul-

phate has proved fatal and half an ounce of the subacetate.

Death usually takes place in from four to twelve hours.

Treatment.—

Emetics or stomach pump.

Whites of eggs stirred up with a little water, given repeatedly.

Milk.

Yellow prussiate of potash.

Soap or a fixed alkali.

Opium to relieve pain.

ZINC COMPOUNDS.

Symptoms.—

Like copper, plus.

Dilated pupils.

Coma.

Death.

Fatal dose and period.—

Sulphate of zinc in a dose of from $\frac{1}{2}$ to 1 ounce will cause death. Death usually takes place within fifteen hours.

The fatal dose of chloride of zinc is not known.

Death may take place within four hours, but it may take months.

Treatment.—

Emetics or stomach pump.

White of egg.

Milk.

Diluent drinks.

Opium for pain.

NITRATE OF SILVER.

Symptoms.—

Like arsenic, plus:—

Insensibility.

Violent convulsions.

Dilated pupils.

Great muscular weakness.

Paralysis.

Disturbed respiration.

Discoloration of lips and skin, first white, then black.

Vertigo.

Brownish or blackish vomit.

Coma.

Death.

Fatal dose and period.—

The fatal dose varies; death has been caused by 30 grains. Recovery has taken place after an ounce had been taken.

Treatment.—

Emetics.

Common salt in large quantities.

Milk in large quantities.

PHOSPHORUS.

Symptoms.—

Like arsenic, but it takes from three to twelve hours for first symptoms to appear. In addition to these symptoms we have:—

Vomit at times smells of phosphorus. In early part is luminous in the dark.

Vomiting stops on second or third day, and begins again with the jaundice, when it becomes of a dark color, due to the mixture with the blood.

Tongue is white or very red.

Loss of appetite.

Thirst.

There is usually fever followed by subnormal temperature. Urine scanty, albuminous, and may contain sugar.

Nervous symptoms develop after jaundice is present.

Delirium.

Coma.

Death.

Fatal dose and period.—

Less than a grain has proved fatal.

Death usually takes place in from one to five days.

Treatment.—

Emetics, albuminous and demulcent drinks with hydrate of magnesia.

Copper sulphate.

“French” oil of turpentine.

Animal charcoal.

Nitrate of silver.

Stimulants.

IODINE.

Symptoms.—

Very few deaths are recorded as caused by it.

Burning heat in the throat, œsophagus and stomach.

Severe pain in the abdomen.

Vomit smells of iodine; is of a yellowish color, except when it consists of starchy substance, in which case it is blue; sometimes it is mixed with blood.

Purging, which may show the presence of iodine.

Pulse small and frequent.

Pallor.

Lessening or suspension of urine, dark brown and rich in iodine.

Eruptions on the skin about the fourth day.

Headache and giddiness.

Thirst and anxiety.

Convulsions

Collapse.

Death.

Fatal dose and period.—

Twenty grains has caused death.

Death usually takes place within ten days.

Treatment.—

Starch in water.

CROTON OIL.

Symptoms.—

Violent vomiting.

Purging.

Symptoms of collapse.

Fatal dose and period.—

Thirty minims have caused death.

Two and one-half drachms have caused death in four hours.

Recovery took place, after taking two and one-half drachms, in fourteen days, after severe vomiting, purging and collapse.

Treatment.—

Emetics.

Demulcent drinks.

Morphine hypodermically.

Symptomatic.

CANTHARIDES.

Symptoms.—

Like arsenic, plus:

Great thirst.

Dry throat.

Dull heavy pains in the loins.

Constant desire to urinate, with great pain,
passing only a few drops of bloody urine.

Priapism in men and swelling and heat of
the labia in women.

Bloody diarrhœa.

May be salivation

Syncope.

Convulsions.

Coma.

Death.

Fatal dose and period.—

Twenty-five grains of the powder and an
ounce of the tincture, each have caused
death within two weeks.

Treatment.—

Emetics or stomach pump.

Demulcent drinks.

Opium per rectum.

Stimulants.

III. NEUROTIC POISONS.

Include.—

Aconite.

Alcohol.

Belladonna.

Chloral hydrate.

Chloroform.

Cocaine.

Cocculus,

Colchicum.
Conium.
Hydrocyanic acid.
Mushroom.
Opium.
Physostigma.
Ptomaines.
Strychnine.

ACONITE.

Symptoms.—

Come on in a few minutes.
Throat dry.
Tingling and numbness of lips, throat and tongue.
Nausea and vomiting.
Pain and tenderness of abdomen.
Numbness and anæsthesia become general.
Vertigo.
Dimness of vision.
Tinnitus aurium—may be deaf.
Frothing of mouth.
Weakness—unable to walk.
Slow, feeble pulse.
Labored breathing.
Cold clammy skin.
Dilated pupils.
Pale features.
Mind is usually clear.
Death may be sudden.
Slight convulsions.

Fatal dose and period.—

Five grains of the extract and eighty minims of the tincture have each caused death.
Death occurs within five hours.

Treatment.—

Empty the stomach—emetics or stomach pump.

Dorsal decubitus, elevate feet.

Stimulate, alcohol, ether, digitalis hypodermically and inject ammonia into the veins.

Artificial respiration.

Nitrite of amyl inhaled.

ALCOHOL.

Symptoms.—

Usually come on in a few minutes.

Giddiness.

Confusion of mind.

Staggering.

Incoherent talking.

Stupor.

Coma.

Face pale or red.

Pupils are usually dilated.

Breath smells of alcohol or aldehyde.

Jerky movement of limbs.

Labored breathing.

Fatal dose and period.—

Fatal dose indefinite.

Death may occur in one half hour, or the patient may appear well, and later die in convulsions.

Treatment.—

Empty stomach—emetic or stomach pump.

Dash cold water over head.

Fresh air.

Electricity.

Ammonia.

Coffee.

BELLADONNA.

Symptoms.—

Usually come on in from one-half to two hours.
Heat and dryness of mouth and throat.
Difficult swallowing.
Respiration accelerated.
Pupils dilated.
Face flushed.
Nausea and vomiting,
Rapid pulse.
Talkative delirium.
Convulsions.
Stupor.
Coma.
Death.

Fatal dose and period.—

One-half to three quarters of a grain of atropine is the minimum adult lethal dose.
Death usually takes place within twenty-four hours.

Treatment.—

Empty stomach—emetics or stomach pump.
Tannic acid given freely.
Pilocarpine hypodermically.
Draw urine.
Stimulate the circulation and respiration, by:
Heat and mustard externally.
Alternate hot and cold douches.
Artificial respiration.
Whisky and ammonia hypodermically.

CHLORAL HYDRATE.

Symptoms.—

Deep sleep.

Pulse slow and feeble.
Respiration slow.
Face pale.
Coma.
Death.

Fatal dose and period.—

Thirty grains has caused death.
Recovery has taken place after the ingestion
of over an ounce.

Treatment.—

Similar to that of opium poisoning.
Alcoholic and external stimulants used freely.
Artificial respiration.
Inhalation of oxygen.
Strychnine hypodermically.
Atropine.
Coffee.
Ammonia.

CHLOROFORM.

Symptoms.—

By the mouth—

Nausea and vomiting.
Colicky pains in abdomen.
Insensibility.
Convulsions.
Dilated pupils.
Flushed face.
Full and oppressed pulse.

Fatal dose and period.—

By the mouth—

One half ounce has often caused death.

By inhalation—

Thirty drops has caused death in one
minute.

Fifteen drops has caused death in a short time.

Treatment.—

By the mouth—

Empty the stomach—emetic or stomach pump.

Stimulate, digitalis, strychnine, etc.

By inhalation—

Withdraw the chloroform.

Fresh air.

Cold affusions to face and chest.

Elevate feet.

Draw tongue out of mouth to facilitate respiration.

Strychnine and digitalis hypodermically.

Artificial respiration.

COCAINE.

Symptoms.—

Great restlessness and nervous excitement.

Accelerated pulse, but it may be slow and feeble.

Respiration increased in frequency.

Muscular twitchings or mild convulsions.

May be nausea and vomiting.

Pupils are dilated.

May have violent epileptiform convulsions.

Consciousness is usually lost.

May have mania with hallucinations and delusions.

Death.

Fatal dose and period.—

Twenty-four grains per rectum proved fatal.

Twenty drops of a 4 per cent solution, given

hypodermically to a girl of twelve years, caused death in forty seconds.

One drachm of a 20 per cent solution, injected into the urethra, caused death in fifteen minutes.

Treatment.—

Emetics.

Digitalis, strychninæ and morphine, hypodermically.

FISH BERRIES.

Symptoms.—

Usually occur within half an hour.

Loss of voluntary power.

Nausea and vomiting.

Severe abdominal pain.

Faintness and confusion of mind.

Dimness of vision.

Excessive thirst.

Pulse weak.

Respiration slow and labored.

Fatal dose and period.—

Fatal dose indefinite.

Death may occur within half an hour.

Treatment.—

Emetics.

Demulcent drinks.

COLCHICUM.

Symptoms.—

Nausea, retching, and uncontrollable vomiting.

Violent purging.

Gripping abdominal pain.

Burning pain in the throat and stomach.

Pulse first frequent and feeble, later rapid and thready.

Cold, clammy, pale or livid skin.

Consciousness is preserved until the last.

Collapse.

Delirium and convulsions may be present.

Fatal dose and period.—

Half an ounce of the wine of the root, forty-five grains of the dried bulb, and a tablespoonful of the seeds have each proved fatal.

Death usually occurs within 24 hours.

Treatment.—

There is no known antidote.

Emetics or stomach pump.

Strychnine.

Digitalis hypodermically.

Caffeine.

Demulcent drinks.

Castor oil.

CONIUM.

Symptoms.—

Headache.

Disturbed vision.

Dilated pupils.

Gradual paralysis of the extremities.

Eyes are kept shut.

Pulse at first diminished, later increased.

Death from paralysis of respiration.

Should death be delayed there may be convulsions, coma, delirium, and paralysis of the sphincters.

Fatal dose and period.—

One drachm of conium is usually a fatal dose.

Death usually takes place within three hours.

Treatment.—

- Emetics.
- Castor oil.
- Strychnine hypodermically.
- Digitalis.
- Whiskey.

HYDROCYANIC ACID and COMPOUNDS.

Symptoms.—

- Come on almost immediately.
- General paralysis.
- Respiration is prolonged and forced.
- Pulse is imperceptible.
- Eyes glassy and prominent.
- Pupils dilated.
- Odor of prussic acid upon the breath.
- Unconsciousness.
- Violent convulsions.
- Death.

Fatal dose and period.—

- Fifty minims of the official acid may be considered the adult lethal dose.
- Death usually occurs within ten to fifteen minutes.

Treatment.—

- Empty stomach.
- Atropine hypodermically.
- Alternate hot and cold douches.
- Ammonia by mouth, inhalation and injection into the veins.
- Chlorine by mouth, inhalation and external application.
- Artificial respiration.
- A mixture of ferrous and ferric sulphate preceded by a cream of carbonate of magnesium and water.

AGARIC—POISONOUS MUSH-ROOM.

Symptoms.—

Usually appear within half an hour.
Violent vomiting and purging.
Abdominal pains.
Dimness of vision.
Dilated pupils.
Delirium.
Stupor.
Coma.
Trembling.
Convulsions.
Death.

Treatment.—

Emetics.
Daturine hypodermically.
Chloroform in 30 drop doses.
Morphine.
Strychnine.
Digitalis.

OPIUM AND MORPHINE.

Symptoms.—

Giddiness.
Stupor.
Clammy skin.
Slow full pulse.
Itching of nose.
Drowsiness.
Coma.
Slow stertorous breathing.
Contracted pupils (pin point.)
Reflexes abolished.
Death from respiratory failure.

Fatal dose and period.—

Four grains may be considered the minimum adult lethal dose.

Death usually takes place in from seven to twelve hours.

Treatment.—

Empty stomach—emetics or stomach pump.

Draw urine.

Atropine hypodermically.

Permanganate of potassium hypodermically.

Strychnine.

Caffeine.

Cocaine.

Electricity.

Cold affusions.

Artificial respiration.

Keep in motion.

PHYSOSTIGMA.

Symptoms.—

Giddiness.

Lessened heart action.

Muscular tremor.

Muscular flaccidity—falls to the ground.

Pupils contract.

Respiration slow, irregular and stertorous.

Reflexes abolished.

Voice is completely lost.

Body temperature is slightly elevated.

Vomiting and purging may be present.

Convulsions may be present.

Consciousness is retained.

Death from paralysis of respiration.

Treatment.--

Empty the stomach—emetics or stomach pump.

Dry heat externally.

Atropine hypodermically, gr., 1/60 every two hours until three doses have been given

STRYCHNINE and NUX VOMICA.

Symptoms.—

Usually appear within one half hour.

Restlessness and general uneasiness.

Twitching of the muscles and jerking of the limbs and head.

Violent tetanic convulsions of the whole body

During contraction of the muscles of the chest and abdomen, respiration is arrested.

Face is livid and congested.

Eyes prominent and staring.

Pupils dilated.

Pulse rapid and feeble.

Consciousness is retained.

Great thirst.

Death from paralysis of respiration.

Fatal dose and period.—

Half a grain is the smallest fatal adult dose.

Recovery has taken place after taking forty grains.

Death usually takes place within an hour.

Treatment.—

Empty the stomach—emetic or stomach pump.

Chloroform by inhalation for convulsions.

Potassium bromide with chloral hydrate in large doses every half hour.

Atropine, when chloroform fails.

Nitrite of amyl by inhalation.

Artificial respiration.

Paraldehyde.

IV. GASEOUS POISONS.

Include:

- Carbonic acid gas.
- Carbon monoxide or illuminating gas.
- Chlorine and bromine gases.
- Coal--illuminating gas.
- Sulphuretted hydrogen gas.

CARBONIC ACID GAS.

Symptoms.—

- Stertorous breathing.
- Oppression.
- Flushed face.
- Eyes protrude.
- Swollen tongue.
- Feeble pulse.

Treatment.—

- Fresh air.
- Alternate hot and cold douches to chest.
- Friction of limbs and trunk.
- Artificial respiration.
- Stimulate—strychninæ, digitalis, etc.

CARBON MONOXIDE OR ILLUMINATING GAS.

Symptoms.—

- Headache.
- Pressure in region of temples.
- Vertigo.
- ringing in the ears.
- ✓Tendency to sleep.
- Loss of muscular power.
- Impaired vision.
- Labored breathing.

Rapid feeble pulse.

Vomiting.

Coma.

Convulsions.

Death from asphyxia; this usually occurs within two hours.

Treatment.—

Fresh air.

Artificial respiration.

Alternate hot and cold douches.

Stimulate.

Electricity.

CHLORINE AND BROMINE GASES.

Symptoms.—

Violent convulsive cough.

Bloody expectoration.

Spasm of the glottis.

Darting pains through the chest.

Sneezing.

Profuse flow of tears.

Pneumonia in severe cases.

Dyspnoea.

Death from asphyxia.

Treatment.—

Fresh air.

Inhalation of warm aqueous vapor of ammonia to form ammonium chloride.

Chloroform.

Narcotics.

COAL GAS—ILLUMINATING GAS.

Symptoms.—

Headache.

Confusion of intellect.
Vertigo.
Nausea and vomiting.
Loss of consciousness and insensibility.
Complete prostration.
Convulsions.
Death from asphyxia.

Treatment.—

Fresh air.
Artificial respiration.
Alternate hot and cold douches.
Stimulate.
Electricity.

SULPHURETTED HYDROGEN GAS.

Symptoms.—

Sense of fullness and pain in the stomach.
Vertigo.
Nausea.
Loss of muscular power and consciousness.
Escape of blood from the mouth.
Body cold.
Face livid.
Pupils dilated and fixed.
Convulsions.
Coma.
Death from asphyxia.

Treatment.--

Fresh air.
Friction.
Warmth.
Stimulate—strychnine, digitalis, etc.

PTOMAINES.

Symptoms.—

These usually come on within thirty-six hours of partaking of the poisonous meat, sausage, milk, shell fish or fish.

Languor and ill health.

Loss of appetite.

Nausea.

Gripping pains in abdomen; diarrhoea and vomiting.

May be chilliness or rigor.

Headache, giddiness or faintness.

Cold sweats.

Stools offensive and of a dark color.

Muscular weakness pronounced.

Intense thirst.

Tongue coated.

Temperature 101 to 104.

Pulse 100 to 125.

Collapse.

Death.

Treatment.—

Symptomatic.

Calomel.

Stimulants.

Demulcents,

Baths.

Food to be given cautiously.

DOSAGE IN GENERAL.

There are numerous conditions which modify the action of drugs, which must be taken into consideration.

Disease often fortifies the system against the action of drugs. In peritonitis and cerebro-spinal fever very large doses of opium are taken with benefit, then again severe pain or delirium tremens greatly retards the production of sleep by opium; spinal disease interferes greatly with purgation; in typhoid fever there is a wonderful tolerance to alcohol. Nevertheless, while the body may tolerate, when diseased, large doses of some drugs, these drugs should never be prescribed in doses that given to healthy persons would cause death.

Habit and Mode of Life have a marked influence on the blood, either causing plethora or anæmia, and they also ward off the action of certain drugs.

If a man becomes accustomed to certain narcotics, such as opium or alcohol, he will fail to some degree to show an effect from their action in medicinal doses.

Thus the opium eater only obtains quietude and ease by taking a dose sufficiently large to kill an ordinary person.

Again, a person who is hardened to exposure and work in the open air requires a much larger dose to affect the system than those who lead a sedentary life.

Interval Between Doses.—A question often puzzling when writing a prescription may arise in regard to the interval between doses: this is determined by the physiological action of the drug and its absorption and elimination, and for some drugs by the condition of the patient or of the organs to which the action of the drug is largely directed.

In general when the intention is to assist the performance of a natural function that occurs at longer intervals, such as sleep, a single dose large enough to decidedly influence the patient should be ordered shortly before the time when under normal circumstances the patient would sleep.

Laxatives usually act more satisfactorily if given at night and allowed to slowly dissolve or spread through the intestines: quickly acting salines are more effective if taken before breakfast.

Drugs such as iodides, bromides, salicylates, arsenic, etc., which are irritating to the gastro-intestinal membranes may be given with better results when these membranes are somewhat protected by food, as just after eating, than at any other time.

Expectorants, which in addition to a systemic action, may be in such form as to have some local action on the throat membranes, are best taken at short intervals, every two or three hours.

The interval between doses should in general correspond with the duration of the effect—thus if the administration of a drug be followed by an effect evident in one hour and persisting for three hours, it is desirable to give the drug at three-hour intervals.

It is good practice to give a safe dose—small as effective—and repeat it at minimum intervals—rather than a large dose at maximum intervals.

Correctives and Synergistics.—When closely analyzed the effects of one drug are never directly opposite to those of another in all respects, and neither do any two exactly parallel each other.

Drugs that are antagonistic in some spheres of action are synergistic in others. Hence it is possible to add to a basic medicament another drug which may overcome some undesirable part of the effect of the first, and at the same time intensify or, at least, not seriously interfere with, the action in other respects.

While not entirely a matter of dosage, this balancing or readjustment of action is largely influenced by the proportions in which the drugs are associated together.

When a synergist or a corrective is added, the dosage of this added drug should be small enough so that its effect will not predominate but only modify the effect of the chosen medicament.

A word of caution should be given regarding the dosage of two mixtures, in each of which the same corrective or synergist may appear. Thus a mixture of diuretics, together with a small dose of atropine, may be ordered to allay irritability of the bladder in cystitis and, while this medicament is being used, if there be given a mixture of laxatives together with a small dose of extract of belladonna included as a corrective for its action on the inhibitory nerves it is evident that the sum total of the belladonna extract and the atropine may be equal to a rather large, or in some cases, even a dangerous dose.

Avoid prescribing mixtures unless each ingredient is carefully selected and the conditions surrounding its administration are well known.

Idiosyncrasy.—This is important, but cannot be foreseen. A patient should always be asked about his peculiarities in regard to taking drugs. Some are affected by the tonic influences of even minute doses of arsenic, some are salivated by a minute dose of a mercurial, some are poisoned by a very small amount of turpentine. Others cannot take quinine, opium, belladonna nor the iodides, and with still others dilute solutions of cocaine applied to the mucous membranes will cause severe toxic symptoms. These idiosyncrasies are innumerable and should always be kept in mind.

Sex.—Men as a rule bear larger doses of medicines than women. Of course in women during pregnancy or at the menstrual period strong drugs should be avoided.

Age.—Children and old people are more easily affected by most drugs, especially the narcotics, than adults in the prime of life, but they bear larger doses of purgatives in proportion. The following rules for dosage, with relation to age can be used:

(a) Dr. Young's is probably the best and most generally useful; it is: add 12 to the age and divide the age by the result. Thus a child of three years $\frac{3}{3+12} = \frac{3}{15} = \frac{1}{5}$ of that of the adult. At the age of twenty-one years the full dose is given.

(b) Dr. Cowling's rule is: divide the patient's next birthday by 24; thus at three years the dose would be $\frac{4}{24}$ or $\frac{1}{6}$ of that of the adult, five years, $\frac{6}{24}$ or $\frac{1}{4}$; 11 years, $\frac{12}{24}$ or $\frac{1}{2}$, etc.

(c) Prof. Clarke has proposed a rule that is based on relative weights. Taking the average weight of an adult at one hundred and fifty pounds, for whom the appropriate dose

is one or one drachm, the dose of the drug must be increased or diminished in proportion of the weight of the patient to that number of pounds. This proportion is represented by a fraction whose numerator is the patient's weight and whose denominator is 150. If a child at birth weighs ten pounds, the proportionate dose for it would be $\frac{10}{150}$ or $\frac{1}{15}$. A child at two years weighing twenty pounds, would require $\frac{20}{150}$ or about $\frac{1}{7}$ of an adult dose. A person whose weight is two hundred pounds should have $\frac{200}{150}$ or $1\frac{1}{3}$ of an average adult dose.

(d) Dr. Lauder-Burton proposes the following rule for calculating the dose for a child, in the metric system. Multiply the next birthday by four and divide the result by one hundred; or what is the same thing, multiply the full dose by the child's next birthday, then by four and remove the decimal point two places to the left. Thus if the dose for an adult be one gramme, that for a child of three years will be .160 gm.

Constitution.—As a rule, the larger and more robust the individual, the less easily he is influenced by drugs.

A LIST OF DRUGS WITH DOSES.

Both the United States Pharmacopœia 1X and National Formulary list an average adult dose for many official articles: these statements in no way limit the physician in the exercise of his judgment and may be either exceeded or reduced.

In the following tables the dosage listed is for adults and covers the average range of the usual requirements of medical practice, but in exceptional cases may be exceeded safely and with benefit.

When a dose larger than usual is prescribed the quantity written should be underlined to show that no error has been made and that the large dose as written is purposely ordered.

Unless so underlined or otherwise marked or checked the pharmacist should make certain by personal inquiry that no error has been made.

In all cases where unusual quantities are ordered the patient should be kept under close observation.

Various ways of administering a drug, whether by mouth, hypodermically, by inunction, by inhalation or intravenously, bring about effects of varying intensity and this variation may be due to one or more of several factors in drug action.

If a drug is so prepared or is so administered that its assimilation or absorption takes place more quickly or in greater quantity for the same period of time, the increased mass thus thrown within a shorter time against the tissue to be influenced, may bring about more intense reaction and more pronounced response by the patient.

When given either hypodermically or intravenously, a drug does not come under the influence of

the contents and secretions of the gastro-intestinal area, but in many cases reaches the field of its action without change.

The condition of the patient himself, varying from time to time, may decidedly influence this absorption or assimilation and the resulting effects. Elimination, if faulty, may bring about cumulative effects out of all proportion to a single dose.

If other conditions are similar the dosage, when given hypodermically, should seldom exceed one-half of that given by the mouth, and when given intravenously should be somewhat less than one-half of the oral and be in a dilute solution: in rectal injections one and one-half times as much may be given; by inunction, twice as much may usually be applied as taken internally by mouth.

These proportions are suggestive only and circumstances in each case may modify them.

Absinthe, 15-30 gr.	Phosphoric, 3-7 min.
Acetanilid, 3-20 gr.	" dil., 5-40 min.
Acid, Acetic, 15-30 min.	Salicylic, 5-20 gr.
Arsenous, $\frac{1}{100}$ - $\frac{1}{10}$ gr.	Sulphuric dil., 10-20 min.
Benzoic, 10-30 gr.	" arom., 5-20 min.
Boric, 10-30 gr.	Tannic, 3-10 gr.
Carbolic, 1-3 gr.	Tartaric, 5-25 gr.
Citric, 10-40 gr.	Valerianic, 2-5 min.
Formic, 3-5 min.	Aconite, $\frac{1}{2}$ -2 gr.
Gallic, 3-30 gr.	Aconite leaves, 1-2 gr.
Hydrobromic Dil, $\frac{1}{2}$ -2 f 3.	Aconitine, $\frac{1}{100}$ - $\frac{1}{10}$ gr.
Hydrochloric, 5-10 min.	Acetphenetidin, 3-15 gr.
" dil. 10-30 min.	Agaricin, $\frac{1}{10}$ - $\frac{1}{4}$ gr.
Hydrocyanic dil., 1-5 min.	Aletrin, $\frac{1}{2}$ -2 gr.
Lactic U. S. P., $\frac{1}{2}$ -2 f 3.	Allium (garlic), 15-60 gr.
Nitric dil. 5-30 min.	Aloes, Barbadoes, $\frac{1}{2}$ -10 gr.
Nitro hydrochloric, 2-5 min.	Aloes, Socotrine, $\frac{1}{2}$ -10 gr.
" " dil., 10-30 min.	Aloin; $\frac{1}{8}$ -2 gr.
Oxalic, $\frac{1}{2}$ -1 gr.	Alum, 10-60 gr.
	Aluminum hydrate, 1-10 gr.

Ammoniac, 5-25 gr.
 Ammonium bromide, 5-60 gr.
 Ammonium carbonate, 5-15 gr.
 Ammonium chloride, 5-30 gr.
 Ammonium iodide, 3-10 gr.
 Ammonia, water of, (10%), 10-30 min.
 Ammonium valerianate, 2-10 gr.
 Amyl nitrite, 2-4 min.
 Aniline, 1-2 gr.
 Anise, 10-30 gr.
 Anthemis, 30-120 gr.
 Antifebrim, 3-20 gr.
 Antimony and potash tartrate, $\frac{1}{8}$ -3 gr.
 Antimony oxysulphide, 1-3 gr.
 Antipyrine, 3-20 gr.
 Apiol, 2-5 min.
 Apomorphine, muriate, $\frac{1}{10}$ - $\frac{1}{4}$ gr.
 Argentic nitrate, $\frac{1}{8}$ - $\frac{1}{2}$ gr.
 Argentic oxide, $\frac{1}{2}$ -2 gr.
 Arnica flowers, 10-20 gr.
 Arnica root, 5-20 gr.
 Arsenic, bromide, $\frac{1}{4}$ - $\frac{1}{2}$ gr.
 Arsenic, chloride, $\frac{1}{10}$ - $\frac{1}{8}$ gr.
 Arsenic, iodide, $\frac{1}{10}$ - $\frac{1}{8}$ gr.
 Assafœtida, 5-60 gr.
 Atropine, $\frac{1}{10}$ - $\frac{1}{50}$ gr.
 " sulphate, $\frac{1}{10}$ - $\frac{1}{50}$ gr.
 Aurum, chloride, $\frac{1}{10}$ - $\frac{1}{8}$ gr.
 Auri et sodii chloridum, $\frac{1}{8}$ - $\frac{1}{10}$ gr.
 Balsam Peru, 10-30 min.
 Balsam copaiba, 5-60 min.
 Berberine, $\frac{1}{4}$ -5 gr.
 Berberine sulphate, 1-10 gr.
 Belladonna leaves, 1-3
 " root, 1-3 gr.
 Bismuth citrate, 1-5 gr.
 Bismuth salicylate, 5-10 gr.
 Subcarbonate, 10-60 gr.
 Subgallate, 5-30 gr.

Subnitrate, 5-100 gr.
 Tannate, 5-30 gr.
 Bromoform, 1-5 min.
 Bryony, 10-60 gr.
 Buchu, 15-60 gr.
 Butyl-chloral, 5-10 gr.
 Caffeine, 1-3 gr.
 " citrate, 1-5 gr.
 Calcium, bromide, 5-60 gr.
 Carbonate, 5-40 gr.
 Chloride, 1-15 gr.
 Hypophosphite, 5-25 gr.
 Iodide, 5-20 gr.
 Phosphate, 10-40 gr.
 Sulphit., $\frac{1}{4}$ -5 gr.
 Calumbo, 5-30 gr.
 Camphor, 1-10 gr.
 Camphor monobromate, 1-5 gr.
 Cannabis indica, 2-5 gr.
 Cannabine tannate, 1-10 gr.
 Capsicum, 3-5 gr.
 Castanæ, $\frac{1}{2}$ -2 dr.
 Catechu, 10-30 gr.
 Caulophyllum, 5-25 gr.
 Caulophyllin, $\frac{1}{2}$ -2 gr.
 Cerium oxalate, 1-5 gr.
 Chenopodium, 10-25 gr.
 Chloral, 5-25 gr.
 Chloroform, 2-8 min.
 Cimicifuga, 10-30 gr.
 Cinchona, 30-60 gr.
 Cinnamon, 10-30 gr.
 Coca, 15-60 gr.
 Cocaine, $\frac{1}{8}$ -2 gr.
 Codeine, $\frac{1}{4}$ -6 gr.
 Codeine sulphate, $\frac{1}{4}$ -6 gr.
 Colchicine, $\frac{1}{10}$ - $\frac{1}{50}$ gr.
 Colocynth, 1-8 gr.
 Colocynthin, $\frac{1}{4}$ -1 gr.
 Conium, 2-5 gr.
 Convallaria, 5-30 gr.
 Creosote, 1-20 gtt.
 Crocus, 5-30 gr.
 Copper Arsenite, $\frac{1}{10}$ -1 gr.
 " Subacetate, $\frac{1}{8}$ - $\frac{1}{2}$ gr.

- Copper Sulphate (emetic), $\frac{1}{2}$ - 10 gr.
 Cubeb, $\frac{1}{4}$ -3 dr.
 Cundurango, 20-40 gr.
 Diacetyl Morphine 1/40-1/12 gr.
 Decoctions, base dose on percentage of drug.
 Digitalis, $\frac{1}{2}$ -3 gr.
 Digitalin, $\frac{1}{4}$ -1 $\frac{1}{2}$ gr.
 Duboisine, $\frac{1}{100}$ - $\frac{1}{50}$.
 Elaterium, $\frac{1}{16}$ - $\frac{1}{2}$ gr.
 Elaterine, $\frac{1}{32}$ -1 $\frac{1}{8}$ grain.
 Elixirs, dose based on drug
 Emetine, 1/120- $\frac{1}{2}$ gr.
 Ergot, 15-60 gr.
 Ergotine, 2-5 gr.
 Eucalyptol, 5-30 min.
 Eucalyptus, $\frac{1}{2}$ -1 dr.
 Euonymin, 2-5 gr.
 Euonymus, 5-30 gr.
 Europhen, 1-5 gr.
 Exalgine, 1-5 gr.
 Extracts and Fluidextracts, dose based on drug strength
 Fel Bovis, 3-10 gr.
 Frangula, $\frac{1}{2}$ -2 dr.
 Galls, $\frac{1}{2}$ -1 dr.
 Gelsemium, $\frac{1}{2}$ -5 gr.
 Gelsemine, $\frac{1}{10}$ - $\frac{1}{20}$ gr.
 Gelsemine, hydrochlorate, Sulphate,
 Tartrate, $\frac{1}{100}$ - $\frac{1}{50}$ gr.
 Gentian, 5-30 gr.
 Ginger, 10-30 gr.
 Glycerine, 10 min.,—2 dr.
 Glycyrrhizin Ammon., 1-5 gr.
 Gossypium, bark of root, 15-60 gr.
 Grindelia, 15-60 gr.
 Guaiac, resin, 5-30 gr.
 Guaiacol, $\frac{1}{2}$ -10 gr.
 Guaiacol carbonate 5-60 gr.
 Guarana, $\frac{1}{4}$ -1 dr.
 Hæmogallol, 2-6 gr.
 Hæmoglobin, 1-3 gr.
 Hellebore, 4-16 gr.
 Helonias, 5-15 gr.
 Homatropine hydrobromate $\frac{1}{100}$ - $\frac{1}{25}$ gr.
 Hydrastis, 1-30 gr.
 Hydrochinon, 5-10 gr.
 Hyoscine hydrobromate, $\frac{1}{100}$ - $\frac{1}{50}$ gr.
 Hyoscyamin, $\frac{1}{8}$ -1 gr.
 Hyoscyamine, $\frac{1}{10}$ - $\frac{1}{20}$ gr.
 Hyoscyamus, 5-15 gr.
 Ichthyol, 3-10 gr.
 Ignatia, 1-2 gr.
 Infusions—dose based on percentage of drug.
 Inula, 15-60 gr.
 Inulin, 1-3 gr.
 Iodoform, $\frac{1}{2}$ -5 gr.
 Iodine, $\frac{1}{4}$ -1 gr.
 Ipecac, $\frac{1}{2}$ -30 gr.
 Iris, 10-30 gr.
 Iron reduced, 1-5 gr.
 Iron, Acetate, 3-10 gr.
 Bromide, $\frac{1}{2}$ -2 gr.
 Carbonate, 5-15 gr.
 Chloride, 1-3 gr.
 Citrate, 3-5 gr.
 and potash tartrate, 10-30 gr.,
 and quinine citrate, 3-10 gr.,
 and strychnine citrate, 1-3 gr.
 Ferrocyanide, 2-5 gr.
 Iodide, 1-5 gr.
 Phosphate, 5-10 gr.
 Pyrophosphate, 2-5 gr.
 Subcarbonate, 5-30 gr.
 Sulphate, 1-5 gr.
 Valerianate, $\frac{1}{2}$ -2 gr.
 Jalap, 10-30 gr.
 Kamala, 1-2 dr.
 Kino, 5-30 gr.
 Kola, 5 gr.-2 dr.
 Koussoo, 2-3 dr.

Krameria, 5-30 gr.
 Lactucarium, 5-60 gr.
 Lead acetate, 1-5 gr.
 Leptandra, 15-60 gr.
 Lithium benzoate, 10-30 gr.
 " bromide, 5-25 gr.
 " carbonate, 3-15 gr.
 " citrate, 3-15 gr.
 " iodide, 1-8 gr.
 " salicylate, 10-30 gr.
 Lobelia, 1-10 gr.
 Lupulin, 5-15 gr.
 Macrotin, $\frac{1}{2}$ -2 gr.
 Magnesia, light, 5-60 gr.
 " heavy, 5-60 gr.
 Magnesia, carbon., 5-60 gr.
 " sulphate, 4-12 dr.
 Manganese, binoxide, 2-10 gr.
 " hypophosphite, 10-30 gr.
 Mass of mercury, 3-10 gr.
 Matricaria, 15-60 gr.
 Menthol, 1-5 gr.
 Mercury, chloride, (ic) $\frac{1}{10}$ - $\frac{1}{10}$ gr.
 Mercury, chloride (ous), $\frac{1}{10}$ -10 gr.
 Mercury, Iodide, (ic) $\frac{1}{10}$ - $\frac{1}{4}$ gr.
 Iodide, (ous) $\frac{1}{2}$ -2 gr.
 Tannate, $\frac{1}{2}$ -1 $\frac{1}{2}$ gr.
 With chalk, 3-10 gr.
 Methyl, salicylate, 1-5 min.
 Mezezeum, 5-15 gr.
 Morphine, 1/16- $\frac{1}{2}$ gr.
 Morphine acet., 1/16- $\frac{1}{2}$ gr.
 Other salts of morphine $\frac{1}{8}$ - $\frac{1}{2}$ gr.
 Naphthaline, 2-10 gr.
 Naphtol, 2-15 gr.
 Naphtol, Alpha, $\frac{1}{2}$ -5 gr.
 Narceine, $\frac{1}{10}$ - $\frac{1}{2}$ gr.
 Narcotine, 2-10 gr.
 Nicotine, $\frac{1}{10}$ gr.
 Nitroglycerine, $\frac{1}{100}$ - $\frac{1}{10}$ gr.
 Nux vomica, $\frac{1}{4}$ -4 gr.

Oil, Almond, bitter, $\frac{1}{4}$ min.
 Almond, sweet, $\frac{1}{2}$ oz.
 Cajeput, 1-5 min.
 Castor, 1 dr.-1 oz.
 Cinnamon, 1-5 min.
 Cloves, 1-5 min.
 Copaiba, 5-15 min.
 Croton, $\frac{1}{2}$ -2 min.
 Cubebs, 5-15 min.
 Erigeron, 5-30 min.
 Eucalyptus, 5-15 min.
 Juniper, 5-15 min.
 Lavander, 1-5 min.
 Linseed, 30 min. 1 oz.
 Morrhuæ, 2-8 dr.
 Olives, 1-16 dr.
 Peppermint, 1-5 min.
 Phosphorated, 1-5 min.
 Rue, 1-4 min.
 Savine, 1-5 min.
 Sandalwood, 5-30 min.
 Sassafras, 1-5 min.
 Turpentine, 5-30 min.
 " rectified, 5-30 min.
 Thyme, 1-5 min.
 Oleoresin capsicum, $\frac{1}{4}$ -1 min.
 " cubeb, 5-30 "
 " ginger, $\frac{1}{2}$ -2 "
 " lupulin, 3-5 "
 " malefern, 20-60 "
 " pepper, $\frac{1}{2}$ -2 "
 Opium, $\frac{1}{4}$ -2 gr.
 Pancreatin, 5-15 gr.
 Papaverine, $\frac{1}{10}$ - $\frac{1}{2}$ gr.
 Paraldehyde, 1-30 min.
 Pariera brava, 30-60 gr.
 Pelletierine, 5-10 gr.
 " tannate, 5-10 gr.
 Pepsin, 1-20 gr.
 Phenacetine, 5-25 gr.
 Phosphorus, $\frac{1}{100}$ - $\frac{1}{10}$ gr.
 Physostigma, $\frac{1}{2}$ -2 gr.
 Physostigmine and salts of $\frac{1}{100}$ - $\frac{1}{10}$ gr.
 Phytolacca, 5-30 gr.

Picrotoxin, 1/100-1/60 gr.
 Pilocarpine salts, $\frac{1}{10}$ - $\frac{1}{4}$ gr.
 Pilocarpus, 5-60 gr.
 Piperazine, 5-8 gr.
 Piperine, 1-10 gr.
 Pix Liquida $\frac{1}{4}$ -1 dr.
 Podophyllin, $\frac{1}{10}$ - $\frac{1}{2}$ gr.
 Podophyllum, 5-30 gr.
 Potash acetate, 5-60 gr.
 " bicarbonate, 10-60 gr.
 " bitartrate, 1-8 dr.
 " bromide, 10-60 gr.
 " carbonate, 10-30 gr.
 " chlorate, 5-15 gr.
 " citrate, 15-60 gr.
 " and soda tartrate, $\frac{1}{8}$ -1 oz.
 " hypophosphite, 5-30 gr.
 " iodide, 5-60 gr.
 " permanganate, $\frac{1}{4}$ -2 gr.
 Propylamine, 1-2 gr.
 Pulsatilla, 1-5 gr.
 Quassia, 10-30 gr.
 Quinine 1-30 gr.
 " acetate, 2-20 gr.
 " arsenate, $\frac{1}{18}$ - $\frac{1}{4}$ gr.
 " bisulphate, 1-20 gr.
 " citrate, 1-20 gr.
 " hydrobromate, 1-20 gr.
 " hydrochlorate, 1-20 gr.
 " iodide, 1-5 gr.
 " phosphate, 1-20 gr.
 " salicylate, 2-30 gr.
 " sulphate, 2-30 gr.
 " tannate, 2-5 gr.
 " valerianate, 1-3 gr.
 Resorcin, 3-10 gr.
 Rhamnus, purshiana, 15-60 gr.
 Rhubarb, 5-30 gr.
 Rhus toxicodendron, 1-5 gr.
 Rumex, $\frac{1}{4}$ -1 dr.

Savine, 5-20 gr.
 Salicin, 5-30 gr.
 Salipyrin, 10-25 gr.
 Salol, 3-15 gr.
 Salophen, 5-15 gr.
 Sanguinaria, 2-30 gr.
 Sanguinarine, $\frac{1}{2}$ -2 gr.
 " nitrate, — $\frac{1}{8}$ gr.
 Santonin, $\frac{1}{4}$ -2 gr.
 Scoparius, 15-60 gr.
 Scilla, 1-3 gr.
 Scillitoxin, $\frac{1}{800}$ gr.
 Senega, 10-20 gr.
 Senna, 15-120 gr.
 Serpentaria, 10-30 gr.
 Soap (U. S. P.), 5-30.
 Sodium acetate, 10-40 gr.
 " arsenate, $\frac{1}{24}$ - $\frac{1}{8}$ gr.
 " benzoate, 10-60 gr.
 " bicarbonate, 10-60 gr.
 " bromide, 10-60 gr.
 " carbonate, 5-15 gr.
 " citrate, 5-15 gr.
 " hypophosphite, 5-20 gr.
 " iodide, 5-60 gr.
 " nitrate, 10-30 gr.
 " phosphate, 15-240 gr.
 " salicylate, 5-60 gr.
 " sulphate, 1-8 dr.
 " sulphate dried, $\frac{1}{2}$ -4 dr.
 " sulphite, 10-60 gr.
 Sparteine sulphate, $\frac{1}{10}$ - $\frac{1}{2}$ gr.
 Spigelia, 15-120 gr.
 Stillingia, 15-60 gr.
 Stramonium leaves, 1-5 gr.
 " seed, 1-3 gr.
 Strontium bromide, }
 " iodide } 5-10 gr.
 " lactate }
 Strophanthin, 1/400-1/100 gr.
 Strychnine and salts, $\frac{1}{10}$ to $\frac{1}{10}$ gr.
 Sulfonal, 5-30 gr.
 Sulphur, 15-90 gr.

Sumbul, 30-60 gr.
 Syrups—base dose on drug strength.
 Tansy, 15-60 gr.
 Taraxacum, 15-240 gr.
 Terebene, 3-10 min.
 Terebinthina Canadensis, 5-30 min.
 Terpin hydrate, 2-10 gr.
 Thein, 1-3 gr.
 Thiol, 2-10 gr.
 Thymol, $\frac{1}{2}$ -2 gr.
 Tinctures—base dose on percentage.
 Trillin, 2-4 gr.
 Trional, 5-20 gr.
 Triticum, 1-8 dr.
 Urethane, 10-40 gr

Uva Ursi, 15-60 gr.
 Valerian, 10-30 gr.
 Veratrin, $\frac{1}{8}$ - $\frac{1}{2}$ gr.
 Veratrine, $\frac{1}{40}$ - $\frac{1}{10}$ gr.
 Veratrum viride, 1-5 gr.
 Viburnum, 15-60 gr.
 Wines—base dose on strength.
 Xanthoxylin, 1-2 gr.
 Xanthoxylum, 5-30 gr.
 Xylol, 10-40 gr.
 Zinc, Acetate, $\frac{1}{2}$ -2 gr.
 Bromide, 1-2 gr.
 Oxide, 1-5 gr.
 Phosphide, $\frac{1}{18}$ - $\frac{1}{3}$ gr.
 Sulphate, 1-3 gr.
 Sulpho Carbolate, 1-3 gr.
 Valerianate, $\frac{1}{2}$ -2 gr.

The following is, as far as it goes, a

CORRECT LIST OF LATIN PHRASES AND ABBREVIATIONS USED IN WRITING PRESCRIPTIONS.

Phrase or Word.	Abbreviation.	Meaning.
A, aa.....		Of each.
Abdomen	Abdom	The belly.
Absente febre.....	Abs. febr.....	In the absence of fever.
Accurate		Accurately.
Ad	Ad	To, up to.
Ad duas vices.....	Ad 2 vic.....	At twice taking.
Ad secundum vicem.....		To the second time.
Ad tertiam vicem		For three times.
Adde, or addantur, addendus, addendo.	Ad. or add.....	Add, or let them be added, to be added by adding.
Ad gratam acidita- tem	Ad grat. acid.....	To an agreeable sourness.
Adhibendus.....		To be administered.
Adjacens	Adjan.....	Adjacent.
Ad libitum.....	Ad lib.....	At pleasure.
Ad move, admove- atur, admoveantur.....		Apply, let it be applied, let them be applied.
Adstante febre.....	Adst. febre.....	When the fever is on.
Adversum	Adv.....	Against.
Aggrediente febre...	Aggred. febre.....	While the fever is coming on.
Agitato vase.....		The vial being shaken.

Phrase or Word.	Abbreviation.	Meaning.
Aliquot.....		Some.
Alter.....		The other.
Alternis horis.....		Every other hour.
Amplus.....		Large.
Ana.....	A., aa.....	Of each.
Aqua.....	Aq.....	Water.
Aqua astricta.....	Aq. astr.....	Frozen water.
Aqua bulliens.....	Aq. bull.....	Boiling water.
Aqua communis ...	Aq. comm.....	Common water.
Aqua fervens.....	Aq. ferv.....	Hot water.
Aqua fontalis or fontis or fonta.....	Aq. font.....	Spring water.
Aqua marina.....	Aq. mar.....	Sea water.
Aqua pluvialis or pluviatilis....	Aq. pluv.....	Rain water.
Aut.....		Or.
Balneum arenæ....	B. A.....	Sand bath.
Balneum mariæ or maris.....	B. M.....	A salt water bath.
Balneum vaporosum or vaporis.....	B. V.....	A vapor bath.
Balsamum.....	Bals.....	Balsam.
Barbadensis.....	B. B., B. B. S.....	Barbadoes.
Bene.....		Well
Bibe.....	Bib.....	Drink.
Bis.....		Twice.
Bis in die.....	Bis in d.....	Twice a day.
Bis in dies.....	Bis in d.....	Twice a day.
Bolus.....	Bol.....	A large pill.
Bulliat, bulliant....	Bull.....	Let boil.
Butyrum.....	But.....	Butter.
Cæruleus.....	Cærul.....	Blue.
Calefactus.....		Warmed.
Calomel.....	Cal.....	Mild chloride of mercury.
Calomelas.....		Calomel or mild chloride of mercury
Capiat.....	Cap.....	Let him (or her) take.
Caute.....		Cautiously.
Charta.....	Chart.....	Paper.
Chartula.....		Small paper.
Cibus.....		Food.
Cochlear, or cochleare cochleatim..	Coch, Cochleat.....	A spoonful, by spoonfuls.

Phrase or Word.	Abbreviation.	Meaning.
Cochlear amplum...	Coch. amp.....	A tablespoonful.
Cochlear magnum...	Coch. mag.....	A large spoonful (about ½ an ounce.)
Cochlear medium, or modicum.....	Coch. med.....	A dessert spoonful (about 2 fluidrachms.)
Cochlear parvum...	Coch. parv.....	A teaspoonful (about 1 fluidrachm.)
Coctio.....	Coct.....	Boiling.
Cola.....	Col.....	Strain.
Colaturæ.....	Colatur.....	To, or of, the strain- ed liquor.
Colatus.....	Colat.....	Strained.
Coletur.....	Colet.....	Let it be strained.
Colentur.....	Colent.....	Let them be strained.
Collutorium.....	Collut.....	A mouth wash.
Collyrium	Collyr., Coll.....	An eye wash.
Coloretur.....		Let it be colored.
Compositus.....	Comp.....	Compounded.
Conciscus.....		Cut.
Confectio.....	Conf.....	Confection.
Congius	Cong.....	A gallon.
Conserva.....	Cons.....	A conserve; also keep (thou).
Continuantur rem- edia.	Cont. rem.....	Let the medicines be continued.
Contusus.....		Bruised.
Coque, coquantur...	Coq	Boil, let them be boiled.
Coque secundum artem	Coq. S. A.....	Boil according to art.
Cor, cordis		The heart.
Cortex.....	Cort.....	The bark.
Coxa		The hip.
Cras, crastinus.....	Crast.....	To-morrow.
Cras mane sumendus.....		To be taken to-mor- row morning.
Cras nocte.....		To-morrow night.
Cras vespere.....		To-morrow evening.
Crastinus.....		For to-morrow early.
Cum	C.....	With.
Da, detur	D., det.....	Give, let be given.
De.....		Of or from.
Debita spissitudo...	Deb. spiss.....	A proper consis- tency.

Phrase or Word.	Abbreviation.	Meaning.
Debitus .....	.....	Due, proper.
Decanta	Dec.....	Pour off.
Decem, decimus.....	.....	Ten, the tenth.
Decoctum.....	Decoct.	A decoction.
Decubitus.....	Decub.	Lying down.
De die in diem.....	De d. in d.	From day to day.
Dentur tales doses		
No. IV.	D. t. d. No. IV.....	Let 4 such doses be given.
Detur in duplo .....	.....	Let twice as much be given.
Dexter, Dextra.....	.....	The right.
Diebus alternis.....	Dieb. alt.....	Every other day.
Diebus tertiis.....	Dieb. tert.....	Every third day.
Dilue, Dilutus.....	Dil.....	Dilute (thou), diluted.
Dimidius.....	Dim.	One half.
Directione propria..	D. P. or direc. prop.	With a proper direction.
Divindatur in partes		
æquales.....	D. in p. aeq.....	Let it be divided into equal parts.
Dividendus, -a, -um.....	.....	To be divided.
Dolor .....	.....	Pain.
Donec .....	.....	Until.
Dosis	D.	A dose.
Durante dolore.....	.....	While the pain lasts.
Eadem (fem).....	.....	The same.
Ejusdem	EjUSD.....	The same.
Electuarium.....	Elect	An electuary.
Emesis .....	.....	Vomiting.
Enema.....	En.....	An enema, a clyster.
Enemata .....	.....	Clyster.
Et.....	.....	And.
Extende	Ext.....	Spread.
Extende super alutam mollem.....	Ex. sup. alt. moll....	Spread thou upon soft leather.
Extractum	Ext	An extract.
Fac, Fiat, Fiant.....	F., Ft	Make, let it be made, let them be made.
Fac pilulas duodecim.....	F. pil Xlj.....	Make 12 pills.
Farina.....	.....	Flour.

Phrase or Word.	Abbreviation.	Meaning.
Febre durante.....	Feb. dur.....	During the fever.
Febris		Fever.
Fervens.....	Ferv	Boiling.
Fiat cataplasma....	Ft. cataplasa.....	Make a poultice.
Fiat ceratum.....	Ft. Cerat.....	Make a cerate.
Filtra.....		Filter (thou).
Filtram, Filtrum.....		A filter.
Fluidus	Fl.....	Liquid.
Formula		A prescription.
Frustillatim	Frust	In little pieces.
Fuerit.....		Shall have been.
Gargarisma	Garg.....	A gargle.
Gradatim.....		By degr'es, grad'ally.
Grana sex pondere.....		Six grains by weight.
Granum.....		Grain, grains.
Gratus.....		Pleasant.
Gutta.....	Gtt	A drop.
Guttæ.....	Gtt	Drops.
Guttatim	Guttat	By drops.
Guttis quibusdam....	Gutt. quibusd.....	With a few drops.
Hautus.....	Haust.....	A draught.
Hebdomida		A week.
Herba		An herb.
Heri.....		Yesterday.
Hic, Hæc, Hoc.....		This.
Hirudo		A leech.
Hora.....	H.....	An hour.
Hora somni.....	H. S. or Hor. som....	Just before going to sleep.
Hora undecima matuna.....		At the eleventh hour of the morning.
Hora decubitus.....	H. D.....	At the hour of going to bed.
Horis intermediis....	Hor. interm.....	In the intermediate hours.
Idem		The same.
Idoneus.....		The proper.
Imprimis.....		First.
Incide, Incisus.....	Inc	Cut (thou), being cut.
Indies.....	Ind.....	From day to day, daily.
Infunde.....	Inf	Pour in.
Infusum	Infus.....	An infusion.

Phrase or Word.	Abbreviation,	Meaning.
Injectio.....		An injection.
Injiciatur.....		Let a clyster be given.
In plumento		In gruel.
Instar		As big as.
Inter.....		Between.
Internus.....		Inner.
Jam.....		Now.
Jentaculum.....	Jent.....	Breakfast.
Julepus, Julepum...	Jul.....	A julep.
Jusculum.....		A broth.
Juxta		Near to.
Kali præparatum, potassæ carbonas.	Kal. ppt.....	Prepared kali, or carbonate or bicarbonate of potash.
Lac		Milk.
Lana.....		Flannel.
Linimentum.....	Liniment.....	A liniment.
Linteum		Lint.
Liquor	Liq.....	A solution.
Lotio.....		A lotion.
Macera	Mac	Macerate.
Magnus.	Mag	Large.
Mane, Mane primo...		In the morning, very early in the morning.
Manus		The hand.
Massa, massa pilularis		Amass, a pill mass.
Medius		Middle.
Mensura		By measure,
Mica panis.....	Mic. pan.....	Crumb of bread.
Minimum.....	M. or min	A minim.
Minutum.....		A minute.
Misce	M	Mix.
Mistura	Mist.....	A mixture.
Mitte, mittatur, mittantur.....		Send, let it be sent, let them be sent.
Modo præscripto....	Mod. Praesc.....	In the manner prescribed.
Mora		Delay.

Phrase or Word.	Abbreviation.	Meaning.
More dictu.....	More dic	In the manner directed.
More solito.....	More sol.....	In the usual manner.
Mortarium.....		A mortar.
Ne tradas sine nummo	Ne tr. s. num.....	Do not deliver it unless paid.
Nisi.....		Unless.
Non.....		Not.
Nox, noctis.....		Night.
Nucha		The nape of the neck.
Numerus.....	No.....	Number.
Nux Moschata.....		A nutmeg.
Octarius.....	O.....	A pint.
Octavus		Eighth.
Octo		Eight.
Oleum lini sineigne.....		Cold-drawn linseed oil.
Oleum olivæ optimum.....	O. O. O.....	Best olive oil.
Omni hora, omni bihorio, omni quad- rante horæ.....	Omn. hor., Omn. bih. Omn. quadr. hor...	Every hour, every two hours, every quarter of an hour.
Omni mane..		Every morning.
Omni nocte.....		Every night.
Opus.....		Need, occasion.
Ovum.....		An egg.
Pannus.....		A rag.
Pars, partis.....		A part.
Partes æquales.....	P. æ.....	Equal parts.
Partitis vicibus.....	Part. vic.....	In divided doses.
Parvulus.....		An infant.
Coch. parvulum.....	Coch. parv.....	A teaspoonful.
Parvus.....		Little.
Pastillus, Pastillum.....		A little ball of paste, to take like a lozenge, etc.
Pediluvium... ..		A foot bath.
Per.....		Through, by.

Phrase or Word.	Abbreviation.	Meaning.
Peracta operatio em- etici		When the operation of the emetic is finished.
Perdeliquium.....		By deliquescence.
Pergo, pergere.....		To go on with.
Phiala prius agitata. P. P. A.....		The bottle having been first shaken.
Pilula.....		A Pill.
Poculum pocillum...Pocul., pocill.....		A cup, a little cup.
Pondere.....P.....		By weight.
Ponduscivile.....		Civil weight (avoir- dupois weight.)
Pondus medicinale.....		Medicinal (apothecaries' weight.)
Pone aurem.....		Behind the ear.
Post singulus sedes, liquidus		After every loose stool.
Potus.....		Drink.
Præparata.....		Prepared.
Prandium..... Prand.....		Dinner.
Primo mane.....		Very early in the morning.
Primus.....		The first.
Pro.....		For.
Pro ratione ætatis.....		According to the age of the patient.
Pro re nata..... P. r. n.		Occasionally.
Pugillus..... Pug.....		A pinch, a grip be- tween the thumb and first two fin- gers.
Pulvis, pulverizatus. Pulv.....		A powder, powdered.
Pyxis.....		A pill box.
Quantum libet, or Quantum placet. or Quantum vis, or Quantum volueris. Q. l., Q. p. Q. v.....		As much as you please.
Quantum sufficiat, or Quantum satis.... Q. S.....		As much as is suffi- cient.
Quaqua hora.....		Each hour.

Phrase or Word.	Abbreviation.	Meaning.
Quaque	Q. Q.....	Each or every.
Quartus		Fourth.
Quater		Four times.
Quatuor		Four.
Quibus		From which.
Quinque		Five.
Quintus		The fifth.
Quoque	Q. Q.....	Also.
Quorum	Quor.	Of which.
Quotidie		Daily.
Ratio		Proportion.
Recens	Rec.....	Fresh.
Recipe	R.....	Take.
Redactus in pulverem, redigatur in pulverem	Red. in pulv., redig. in pulv.....	Let it be reduced to powder.
Regio umbilici.....		The umbilical region.
Reliquus.....		Remaining.
Repetatur, repetantur	Rept.	Let it be repeated, let them be repeated.
Respondere		To answer.
Retinere.....		To keep.
Saltem		At least.
Scatula.....	Scat.....	A box.
Scilicet.....		Namely.
Secundum artem, secundum naturam..	S. A., S. N.....	According to art, according to nature.
Secundus.....		Second.
Sedes		The alvine evacuation.
Semel		Once.
Semis	Ss.	A half.
Semidrachma	Semidr.....	Half a drachm.
Semihora	Semih.....	Half an hour.
Septem		Seven.
Septimana		A week.
Sescuncia.....		An ounce and a half.
Sesquihora		An hour and a half.
Sex		Six.

Phrase or Word.	Abbreviation.	Meaning.
Sextus		Sixth.
Si		If.
Sic, Sic?		So, is it so?
Signa	Sig.	Mark thou.
Signetur nomine proprio		Let it be written upon with the proper name (not with the trade name).
Simul		Together.
Sine		Without.
Singulorum	Sing.	Of each.
Si non valeat	Si n. val.	If it does not answer.
Si opus sit	Si. op. sit.	If necessary.
Si vires permittant	Si ver. perm.	If the strength will bear it.
Sit		Let it be.
Solus		Alone.
Solve		Dissolve.
Solvo, solvere, solutus		To dissolve, dissolved.
Somnus		Sleep.
Spiritus vini rectificatus		Rectified spirit of wine.
Spiritus vini tenuis		Proof spirit.
Spiritus vinosus		Ardent spirit of any strength.
Statim	Stat.	Immediately.
Stet, Stent	St.	Let it stand, let them stand.
Stratum super stratum	S. S. S.	Layer upon layer.
Subactus		Subdued.
Sub finem coctionis		When the boiling is nearly finished.
Subinde		Frequently.
Sumat talem		Let the patient take one like this.
Sume, sumat, sumatur, sumantur, sumendus	Sum	Take (thou), let him take, let it be taken, let them be taken, to be taken.

Phrase or Word.	Abbreviation.	Meaning.
Summitates.....		The summits or tops.
Superbibendo haus- tum.....		Drinking afterwards this draught.
Supra.....		Above.
Tabella (dim. of tab- ula, a table.).....	Tabel.....	A lozenge.
Talis.....		Such, like this.
Tempori dextro.....		To the right temple.
Tempus temporis.....		Time or temple.
Ter.....		Three times.
Ter in die, or terdie	T. i. d., or T. d.....	Three times a day.
Tere.....	Tre.....	Rub.
Tero.....		I rub.
Tertius.....		Third.
Tinctura.....	Tinct.....	Tincture.
Tres.....		Three.
Triduum.....		Three days.
Tritura.....	Trit.....	Triturate.
Trochisci.....	Troch.....	Lozenges.
Tussis.....		A cough.
Ultimo (or Ultima) præscriptus.....	Ult. præsc.....	The last ordered.
Una.....		Together.
Uncia.....		An ounce.
Ut dictum.....	Ut dic.....	As directed.
Utendum.....	Utend.....	To be used.
Uto uti.....		To make use of.
Vas vitreum.....		A glass vessel.
Vehiculum.....		A vehicle.
Vel.....		Or.
Venæsectio brachii.....		Bleeding in the arm.
Vesper, vespers.....	Vesp.....	The evening.
Vices.....		Turns.
Vires.....		Strength.
Vitellus.....		Yolk.
Vitello ovi solutus.....		Dissolved in the white of an egg.
Vitreum, vitrum.....		Glass.
Vomitioe urgente..	Vom. urg.....	The vomiting being troublesome.

NUMERALS.

CARDINALS.

Unus.....	One.
Duo.....	Two.
Tres.....	Three.
Quatuor.....	Four.
Quinque.....	Five.
Sex.....	Six.
Septem.....	Seven.
Octo.....	Eight.
Novem.....	Nine.
Decem.....	Ten.
Undecim.....	Eleven.
Duodecim.....	Twelve.
Tredecim.....	Thirteen.
Quatuordecim.....	Fourteen.
Quindecim.....	Fifteen.
Sexdecim.....	Sixteen.
Septemdecim.....	Seventeen.
Octodecim or duo de viginti.....	Eighteen.
Novemdecim or un de viginti.....	Nineteen.
Viginti.....	Twenty.
Viginti unus or unus et viginti.....	Twenty-one.
Triginta.....	Thirty.
Quadraginta.....	Forty.
Quinquaginta.....	Fifty.
Sexaginta.....	Sixty.
Septuaginta.....	Seventy.
Octoginta.....	Eighty.
Nonaginta.....	Ninety.
Centum.....	One hundred.
Ducenti.....	Two hundred.
Mille.....	One Thousand.

ORDINALS.

Primus.....	First.
Secundus.....	Second.
Tertius.....	Third.
Quartus.....	Fourth.
Quintus.....	Fifth.
Sextus.....	Sixth.
Septimus.....	Seventh.
Octavus.....	Eighth.
Nonus.....	Ninth.
Decimus.....	Tenth.
Undecimus.....	Eleventh.
Duodecimus.....	Twelfth.
Tertius decimus.....	Thirteenth.
Quartus decimus.....	Fourteenth.
Quintus decimus.....	Fifteenth.
Sextus decimus.....	Sixteenth.
Septimus deci- mus.....	Seventeenth.
Octavus deci- mus.....	Eighteenth.
Nonus decimus.....	Nineteenth.
Vicesimus.....	Twentieth.
Vicesimus pri- mus.....	Twenty-first.
Tricesimus.....	Thirtieth.
Quadragesimus.....	Fortieth.
Quinquagesimus.....	Fiftieth.
Sexagesimus.....	Sixtieth.
Septuagesimus.....	Seventieth.
Octogesimus.....	Eightieth.
Nonagesimus.....	Ninetieth.
Centesimus.....	Hundredth.
Millesimus.....	Thousandth.

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